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Public Expenditure Allocation in Africa:

An Exploratory Analysis

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This paper is prepared by A.A.G. Ali and Abebe Shimelis in the context of the Growth for Sustained Poverty Reduction Team.

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I. Introduction

1. The International Development Goals (IDGs) for 2015 endorsed by the international development community cover a range of economic and social areas, including poverty reduction, improved access to health and education, movement towards gender equality, environmental sustainability and good governance. These goals provide a useful benchmark against which to measure development efforts and progress. Increasingly, they are expected to influence policy making in developing countries including issues related to the management of public resources.

2. Consistent with the IDGs there is an emerging consensus, among donors and African governments, that the overarching objective of African development is the reduction of poverty in the short and medium runs and its eradication in the long run. In developing such a consensus it is recognized that as Africa enters the 21st century it suffers from many, complex and dynamic facets of deprivations. Further, it is appreciated that many of the previously identified social development goals were not achieved by the majority of African countries (e.g. the World Health Organization's strategy for health for all by the year 2000).

3. As is probably well known the poverty reduction goal is to reduce the proportion of people living in extreme poverty in developing countries by at least one half by the year 2015. One possible interpretation of this objective is that it aims at widening the opportunities for the poor. Allowing for the distribution of income to change, and starting in the year 2000, African GDP needs to grow by about 8% per annum to achieve this objective. In the context of public expenditure the poverty reduction goal can be taken as the objective of government policy.

4. Goals relevant to public expenditure allocation at any point in time are the education and health goals. The education goal is to achieve universal primary education in all countries by the year 2015. On the other hand, the health goals include the reduction, by two thirds from their 1999 level, of infant and child death rates by the year 2015 in each developing country; the reduction of the rate of maternal mortality by three-fourths between 1999 and 2015; and, ensuring of availability of reproductive health services, through the primary health care system, for all individuals of appropriate ages by the year 2015 at the latest.

5. The issue of public expenditure reallocation is also justified on grounds that it serves the objectives of both equity and efficiency at the same time. There is no inherent trade-off, as may be the case in other instances, between the two considerations of public expenditure policy. In fact, allocations of public funds on factors that bear directly on human development help expand the scope of opportunities to households, enhances the quality of human capital required for development, and broadens the benefit of growth to reach as many people as possible (see for instance, Griffin and McKinely (1996) for further discussion).

6. Having noted the above, the rest of this paper is organized in five sections. Section II outlines the theoretical framework for reallocating public expenditure and develops the optimal allocation rule. The theoretical framework posits poverty reduction as the objective function for the government which is optimized subject to its expenditure constraint. As a result and in order to apply the framework, section III reviews the latest results on poverty in Africa while section IV looks very briefly at public expenditure. Following these, section

V reports the results of applying the optimal allocation rules for the case of education. Section (VI) is conclusion.

II. Theoretical Framework

7. Consistent with the International Development Goals it will be assumed that the aim of public expenditure policy is to reduce poverty in the economy. To derive the optimal allocation rules for government expenditure we start by looking at the characteristics of the poverty index. Suppose that P is a poverty index which is a function of a poverty line, z , mean income, μ , and an inequality of income distribution parameter, m . A standard assumption to make is that the poverty index is homogeneous of degree zero in the poverty line and mean income, a property common to the most widely used poverty measures. The generalized poverty index can be written as:

$$(1) \quad P = P(\mu/z, m), \quad \partial P/\partial \mu < 0, \quad \partial P/\partial m > 0$$

8. Plausible restrictions on the poverty index function are that : (a) its partial with respect to mean income is negative implying that, for a given inequality, an increase in mean income (the poverty line) will be expected to lead to a reduction (an increase) in poverty, and (b) its partial with respect to the inequality index is positive implying that an increase in inequality, for a given mean income, will be expected to lead to an increase in poverty. Following the literature m can be treated as the Gini coefficient.

9. Total logarithmic differentiation of (1) will give rise to the following decomposition of a percentage change in the poverty index, where η is the elasticity of the poverty index with respect to mean income and ν is its elasticity with respect to the distribution parameter:

$$(2) \quad dP/P = \eta [d\mu/\mu - dz/z] + \nu dm/m$$

10. Equation (2) can be considered as a complete decomposition of a change in poverty between a growth component and a distribution component. If we assume that the poverty line is a function of mean income, as seems reasonable specially in the context of growing economies, then a complete decomposition of the change in poverty can be obtained as follows:

$$(3) \quad dP/P = \eta(1-\epsilon) d\mu/\mu + \nu dm/m$$

where ϵ is the elasticity of the poverty line with respect to mean income. The growth component of the change in poverty is now conditional on the size of this elasticity. In general, the poverty line is inelastic with respect to mean income (i.e. $\epsilon < 1$) and as such, for a constant degree of inequality, growth will be expected to lead to a reduction in poverty.

11. Budget allocations are usually done on a year to year basis and they are as such short run decisions. Given this, the analysis can be conducted by assuming that no changes in the distribution of income will be observed over the fiscal year (i.e. $dm/m = 0$). However, even if distribution is changing we can envisage the distribution of income to be a function of mean income through a Kuznets relationship. This will make m a function of

mean income (say, $m = m(\mu)$). In what follows we simplify by assuming m constant. Thus, without loss of generality we can write the poverty index as :

$$(4) \quad P = P(\mu), \quad dP/d\mu < 0 \text{ and } (dP/d\mu)(\mu/P) = \eta(1-\epsilon)$$

12. Poverty in the country can be looked at as poverty in the various sectors. A standard sectoral composition is by resident areas, normally rural and urban. Most of the poverty measures in use are additively separable in sectoral poverty with population weights. As such, therefore, we can write the poverty index as:

$$(5) \quad P = \beta^r P^r(\mu^r) + \beta^u P^u(\mu^u)$$

Introduction of density variable

where μ^r and μ^u are mean incomes in the rural and urban sectors respectively and β^r is the share of rural population in total population and β^u is share of urban population in total population. In what follows it will be assumed that government expenditure affects sectoral mean incomes so that both μ^r and μ^u are functions of mean government expenditure in each sector.

13. Total government expenditure for the fiscal year is assumed fixed and can be written in terms of mean expenditure allocated to each sector a^i as:

$$(6) \quad a = \beta^u a^u + \beta^r a^r$$

14. The government's problem is to minimize (5) subject to (6). Solving the optimization problem, under the assumption that the second order conditions will be satisfied, gives rise to the following optimal allocation rule:

$$(7) \quad a^i = \varphi^i / \Sigma \beta^j \varphi^j$$

Where i and $j = r, u$ and where for the relevant sector φ is given by:

$$(8) \quad \varphi = P\eta(1-\epsilon)\theta$$

15. Similarly, for each sector θ is the elasticity of average income in the sector with respect to public expenditure allocated to the sector.

III. Poverty in Africa

16. Indicators of deprivation relevant to issues of public expenditure allocation are usually reported in household budget surveys. For a sample of 21 African countries such indicators are reported in the World Bank (1999) for the rural and urban sectors. They include education indicators (a set of primary enrolment rates and a set of literacy rates) and health indicators (access to sanitation and access to clean water). A summary of these indicators is provided in the following table.

Table 1: Major Characteristics of Rural and Urban Sectors in SSA in the 1990s

Indicator	Rural Sector	Urban Sector
Average Household Size (persons)	06.34	05.71
Population below 15 years (%)	47.80	44.06
Net Primary enrollment (%)	36.50	62.59
Male Primary enrollment (%)	40.59	65.65
Female Primary enrollment (%)	33.06	60.40
Literacy Rate (%)	36.37	57.65
Male Literacy Rate (%)	45.63	66.25
Female Literacy Rate (%)	28.26	49.60
Female Headed Households (%)	19.14	47.60
Heads in agro-pastoral activities (%)	76.98	17.56
Access to Sanitation (%)	40.94	77.80
Access to Piped water (%)	18.75	70.70

Source: World Bank (1999)

17. A number of features relevant to issues of public expenditure allocation can be identified from the above information. For the rural sector the most important are:

- (a) the African rural sector accounts for 75% of the total population. The population of the sector is young with 48% below the age of 15 years;
- (b) the sector suffers from a fairly high degree of deprivation in education. Only 63.0% of the rural children of primary school age (6-13 years) are enrolled in primary education. The net primary enrollment ratio for male children is higher (40.59%) than for female children (33.06%) reflecting an aspect of gender bias. Similarly, the average literacy rate (the proportion of the population above the age of 15 years who are able to read and write) is reported as only 36.4% with male literacy (45.6%) higher than female literacy (28.3%);
- (c) the sector suffers from a fairly high degree of deprivation in health as reflected in access to piped water and sanitation. Only 19% and 41% of the rural population have access to piped water and sanitation respectively.

18. Similar features can be identified for the African urban sector. The sector has a fairly young population where on average 42% of the population is below the age of 15 years. Not unexpectedly, the table reflects a medium degree of deprivation in the urban sector compared to that prevailing in the rural sector. Thus, for example, 62.6% of the African urban African children of primary school age (6-13 years) are enrolled in primary education. A slight gender bias in education is also recorded for this sector where net primary enrollment ratio for male children is higher (66%) than for female children (60%). Literacy rate results also confirm the above picture of medium urban deprivation compared to the rural sector. The average literacy rate is 58% with male literacy rate of 66% and female literacy rate of 50%. Urban health achievements also paint a contrasting picture to that of a very high degree of deprivation in the rural sector. On average 70% and 77% of the urban population have access to piped water and sanitation respectively.

19. The capability to enjoy a decent standard of living can be looked at in terms of money metric measures of poverty. A summary of the most recent poverty results based on such an approach and using appropriate methodology is reported in table (2). These are simple averages of poverty measures for the countries in the sample (see annex table (A.1) for details). The overall poverty results are weighted means for the urban and rural sectors with the weight of the rural sector being 75% of the total population as noted earlier.

Table 2: Poverty in Africa in the 1990s

Poverty Indicator	Rural Sector	Urban Sector	Overall
Head-Count Ratio (%)	55.58	43.03	52.30
Poverty-Gap Ratio (%)	23.42	16.12	21.50
Squared Poverty-Gap Ratio (%)	13.26	08.28	11.96
Mean Expenditure (\$/person/year)	408.56	958.95	551.00*
Mean Poverty Line (\$/person/year)	324.57	558.44	441.50*

Source: Ali (1999). * simple averages

20. From the above summary it is perhaps clear that poverty in the rural sector was very wide spread where nearly 56% of the rural population are found to be living below the poverty line of approximately \$ 325 per year per person. African rural poverty is also found to be deep, as reflected by a poverty-gap ratio of 23%, and severe, as reflected by a squared poverty-gap ratio of 13%. The average income of the rural poor amounts to only \$163 per person per year, which is half of the poverty line.

21. The table also shows that Africa boasts a relatively high incidence of urban poverty with 43 % of the urban population living below a poverty line of \$558 per year per person. Urban poverty is also found to be moderately deep, as reflected by a poverty-gap ratio of 16%, and relatively severe, as reflected by a squared poverty-gap ratio of 8.3%. The average income of the urban poor amounts to only \$352 per person per year or \$29 per person per month.

22. In general, policy formulation would have to be concerned with the issue of how sensitive is poverty to growth in mean income and to changes in income inequality. The answer could be obtained by looking at in terms of the elasticity of any poverty measure with respect to the relevant variable. Directly computed elasticities, averaged over the countries in the sample, are reported in table (3) below.

Table 3: Responsiveness of African Poverty to Growth and Distribution

Poverty Index	Rural		Urban	
	Elasticity with respect to Mean Expenditure: η	Elasticity with respect to the Gini Coefficient: v	Elasticity with respect to Mean Expenditure: η	Elasticity with respect to the Gini Coefficient: v
Head count Ratio	-1.17	0.34	-1.24	0.84
Poverty Gap Ratio	-1.66	1.67	-1.84	2.82
Squared Poverty Gap Ratio	-1.99	2.97	-2.23	4.72

Source: Ali (1999), based on Povcal results

23. In terms of its sensitivity to its major determinants African rural poverty exhibits a pattern which is now becoming stylized for the three poverty measures used. Thus, for example, the head-count ratio is relatively more responsive to growth in income than to changes in the distribution of income. A one percent increase in mean income leads to a 1.17 percentage point reduction in poverty while a one percent increase in the Gini coefficient leads to an increase in poverty by 0.34 of a percentage point. At the other end, for the squared poverty-gap African rural poverty is more sensitive to changes in income inequality than in mean income. An increase in mean income by one percent reduces poverty by 2 percentage points while a reduction in inequality by one percent reduces poverty by 2.9 percentage points.

24. The response of African urban poverty is more regular than that of rural poverty, in the sense that poverty is more sensitive to distribution factors than to growth variables except for the headcount ratio. The elasticity of poverty measures with respect to the Gini coefficient is greater than the absolute value of the elasticity with respect to mean income. Moreover, the magnitude of the response is higher for urban poverty compared to that of rural poverty.

IV. Public Expenditure in Africa

25. Public expenditure information is usually difficult to get for a large number of countries. This is even more true for low income countries. Thus, for example, for the 30 African countries included in the Special Program of Assistance (SPA) such information was available for only 18 countries. For this sample of 18 countries a summary is reported in table (4).

Table 4: Public Expenditure on Education and Health in a Sample of African Countries: A Summary

Indicator	Education Spending (% GDP)	Health Spending (% GDP)	Per Capita Education Spending (current \$)	Per Capita Health Spending (current \$)	Per Capita Education Spending (real 1998 \$)	Per Capita Health Spending (real 1998 \$)	Per Capita Education Spending (real 1999 \$)	Per Capita Health Spending (real 1999 \$)
Mean	3.64	1.66	11.83	4.99	13.99	5.91	14.63	6.17
Maximum	6.70	2.90	35.88	10.26	40.57	11.01	42.60	11.56
Minimum	0.90	0.20	1.69	0.38	1.46	0.32	1.52	0.34
S. Deviation	1.38	0.77	8.31	2.72	10.08	3.36	10.54	3.47

Source: World Bank (1999b).

26. For most of the countries in the above sample the information pertains to 1999 except for three countries: Burkina Faso (1998), Eritrea (1997) and Ghana (1998). From the above summary average public expenditure on education in Africa in 1999 amounted to 3.6% of GDP while on health amounted to 1.7% of GDP. Countries, however, differed as to the resources they devote to these sectors. The maximum expenditure on education of 6.7% of GDP is reported for Kenya followed by Cote d'Ivoire and Eritrea each with education expenditure of 5.1% of GDP. Malawi and Comoros each devotes 4.8% of GDP for education. At the other end the lowest education expenditure figure is reported for Burundi with only 0.9% of GDP followed by Guinea Bissau (1.8% of GDP).

27. The table also reports per capita expenditure on education. It is seen that in current dollars such expenditure averages \$11.8 for the countries of the sample. A maximum of \$35.9 per capita education expenditure is recorded for Cote d'Ivoire while a minimum of \$1.7 is recorded for Burundi. Per capita education expenditure of less than \$10 is recorded for six countries: Burkina Faso (\$8.1), CAR (\$8.8), Eritrea (\$9.2), Ethiopia (\$3.9), Guinea Bissau (\$4.2), and Mozambique (\$3.7).

28. Similar results can be read from the above summary on average public expenditure on health. Thus, as noted above average health expenditure in Africa in 1999 amounted to 1.7% of GDP. Countries, however, differed as to the resources they devote to these sectors. The maximum expenditure on health of 2.9% of GDP is reported for Eritrea followed by Burkina Faso (2.6%) and CAR, Comoros and Malawi each with health expenditure of 2.4% of GDP. At the other end the lowest health expenditure figure is reported for Burundi with only 0.2% of GDP followed by Senegal and Uganda (each with health expenditure of only 0.8% of GDP).

29. The table also reports per capita expenditure on health. It is seen that in current dollars such expenditure averages \$5 for the countries of the sample. A maximum of \$10 per capita health expenditure is recorded for Zambia while a minimum of \$0.4 is recorded for Burundi. Per capita health expenditure of less than \$3 is recorded for four countries: Ethiopia (\$1.8), Guinea Bissau (\$2.1), Mozambique (\$1.8) and Uganda (\$2.5).

30. Information on the allocation of public expenditure within a given social sector is even more difficult to come by. However, for a sample of African countries such information has recently been reported by Gupta, Honjo and Verhoeven (1997), hereinafter GHV (1997). The sources of compiling the data include the World Bank's "poverty assessment reports" and the IMF's Government Finance Statistics. The available data spans the period 1990-1995. Table (5) summarizes the results for the education sector where the sub-sectors are primary, secondary, tertiary and other. The "other" category varies from country to country and includes items such as unallocated administrative expenses, adult education, vocational and technical training.

Table 5: Intrasectoral Allocation of Education Expenditure in Selected African Countries (% of total)

Indicator	Primary	Secondary	Primary & Secondary	Tertiary	Other
Average	47.6	24.2	71.8	20.6	07.6
Maximum	60.0	43.2	85.6	35.0	30.6
Minimum	38.6	11.4	57.0	05.5	00.0
S. Deviation	05.8	08.8	08.9	07.7	10.0

Source: see annex table (A.x)

31. The table shows that in Africa, on average, 48% of the education expenditure is allocated to the primary level of schooling, 24% to the secondary level and 21% to the tertiary level. As is expected there exists a lot of variation between the countries of the sample. Thus, for example, at the primary level the maximum of 60% of total education expenditure is recorded for Kenya followed by CAR (56%), Guinea Bissau (54%), Lesotho (52%), Mozambique (50%) and Tanzania (52%). The minimum of 38.6% of education expenditure allocated to the primary level is recorded for Sierra Leone, followed by Togo (41%), Ghana (41.5%), and Niger (42%).

32. Similarly, there exists a lot of variation between the countries of the sample as relates to the expenditure allocated to the secondary level. Thus, for example, the maximum of 43.2% of total education expenditure going to the secondary level is recorded for Ghana followed by Mozambique (35.6%), Cote d'Ivoire (33.5%), Zimbabwe (30.6%) and Lesotho (30%). The minimum of 11.4% of education expenditure allocated to this level is recorded for Guinea Bissau, followed by Zambia (12.1%), Tanzania (13.0%), and Togo and CAR (16% each).

33. Public expenditure on the tertiary level averaged 20.6% of the total. The maximum allocation of 35% is recorded for Tanzania, followed by Guinea (33%) and Sierra Leone (29.6%). The minimum allocation of 5.5% is recorded for Guinea Bissau, followed by Zambia (11.5%), Ethiopia (13.0%), Mozambique (14.4%), and Lesotho (15.0%).

34. For a sample of 14 African countries table (6) reports the health expenditure allocation between preventive, primary, health care and curative, tertiary hospital, health care sub-sectors. The years covered span the period 1989-1994.

Table 6: Health Expenditure Allocations Between Preventive and Curative Health Care in Selected African Countries

No.	Country	Year	Preventive/Primary Health Care	Curative/Tertiary Hospital Health Care
1	Angola	1992	6.0	48.5
2	Burundi	1993	24.2	42.3
3	CAR	1991	5.0	95.0
4	Cote d'Ivoire	1995	42.5	57.5
5	Ethiopia	1995	50.0	50.0
6	Gambia	1991	63.0	37.0
7	Ghana	1992	32.2	67.8
8	Guinea	1991-94	24.0	62.0
9	Kenya	1991	27.6	68.8
10	Lesotho	1990-91	5.0	95.0
11	Madagascar	1993	52.2	47.8
12	Uganda	1991-92	10.0	90.0
13	Tanzania	1993-94	14.0	79.0
14	Zimbabwe	1989	16.0	84.0
	Mean		26.6	66.1
	S.Deviation		19.1	19.9
	Maximum		63.0	95.0
	Minimum		5.0	37.0

Source: Gupta, Honjo and Verhoeven (1997)

35. The table shows that in Africa, on average, 27% of the public health expenditure is allocated to the preventive health care level while 66.1% is allocated to the curative health care level. The figures do not sum to 100 due to reporting inaccuracies in some countries of the sample. As is expected there exists a lot of variation between the countries of the sample. Thus, for example, at the preventive health level the maximum of 63% of total health expenditure is recorded for Gambia followed by Madagascar (52.2%), Ethiopia (50%), and Cote d'Ivoire (42.5%). The minimum of 5.0% of health expenditure allocated to the preventive level is recorded for CAR and Lesotho, followed by Angola (6%), Uganda (10%), and Tanzania (14%).

36. Similarly, there exists a lot of variation between the countries of the sample as relates to the expenditure allocated to the curative health care level. Thus, for example, the maximum of 95% of total health expenditure going to the curative level is recorded for CAR and Lesotho followed by Uganda (90%), Zimbabwe (84%) and Tanzania (79%). The minimum of 37% of health expenditure allocated to this health care level is recorded for Gambia, followed by Burundi (42%), Madagascar (47.8%), and Angola (48.5%).

37. GHV (1997) also provide elasticity estimates for social sector spending on social indicators. Indicators of educational attainment (primary school enrollment, secondary school enrollment and illiteracy) and of health outputs (life expectancy, infant mortality, and immunization against measles and DPT) are taken as dependent variables. Average per capita spending on education and health (in PPP dollars) are taken as independent variables reflecting the input of the government in the social sector. The data for education spending were averaged over three periods (1984-87, 1988-91 and 1992-95) while the data on health spending were averaged over two periods (1984-89 and 1990-95). Thus, for education three observations were available per country while for health two observations were available per country. A log-linear regression form was run on a sample of 38 African countries for which data was available. Including an initial level of development variable in the regression did not improve the performance of the simple input-output format for which all estimated coefficients were found to be significant at the 5 percent level.

Table 7: Elasticity of Social Indicators to Public Spending in Africa

Log Social Indicator	Intercept	Log Per Capita Spending on Education	Log Per Capita Spending on Health	Adjusted R ²
Primary Enrollment	2.11 (4.2)	0.26 (4.7)		0.38
Secondary Enrollment	-1.79 (-2.6)	0.55 (7.4)		0.60
Illiteracy	5.80 (11.8)	-0.24 (-4.2)		0.33
Life Expectancy	3.49 (19.0)	0.06 (2.7)	0.06 (2.7)	0.35
Infant Mortality	6.00 (9.5)	-0.21 (-2.4)	-0.21 (-2.4)	0.34
Measles Inoculation	2.81 (6.8)	0.15 (3.0)	0.15 (3.0)	0.18
DPT Inoculation	2.53 (5.1)	0.17 (2.7)	0.17 (2.7)	0.12

Source: GHV (1997: p. 17, table 1). Figures between brackets are t-values

38. According to the above results an increase in per capita spending on education of 10 percent is likely to lead to an increase in primary enrollment of 2.1 percent and in secondary enrollment of 5.5 percent and a decrease in illiteracy rate of 2.4 percent. Similarly, an increase in per capita spending on health is expected to lead to increases in life expectancy by 0.6 percent, measles inoculation of 1.5 percent and DPT inoculation of 1.7 percent and a reduction in the infant mortality rate by 2.1 percent.

39. Comparing the results for Africa with a set of results obtained for a pooled sample of 85 developing countries using the same methodology the authors found that the African elasticity estimates are larger than those for the larger sample in all cases except for the illiteracy rate and infant mortality. They concluded that “government spending on education and health has a stronger impact in Africa than elsewhere” (GHV (1997: 19)).

V. Applying the Optimal Allocation Rules

40. On the basis of the information reviewed in the above sections we are now in a position to apply the optimal allocation rules derived in section (II). For each country, estimates of elasticity of the headcount ratio¹ with respect to changes in mean per capita income was obtained for rural and urban areas using income distribution information reported in World Bank (199a). Elasticity of the poverty line with respect to mean per capita income is based on an estimated equation for Sub-Saharan Africa²

41. Elasticity of public expenditure on education and health with respect to mean per capita expenditure (that is the value of θ for rural and urban sectors) was estimated for the sample of African countries for which such data was available for both urban and rural sectors. According to the regression results, generally health expenditure turned out to be related negatively under all specifications with respect to mean income for rural areas, and the coefficients also happen to be statistically significant (see Table 8 for details). For urban areas, a quadratic semi-log specification of mean income with respect to health yielded a turning point occurring at the mean of per capita public expenditure on health (about 5\$). Equation (9) and (10) provide estimates of coefficients of regression of urban and rural mean per capita income on real per capita education and health expenditures.

$$(9) \dots \text{LNMU} = 5.6040 + .091680 \text{EDU} - .0016544 (\text{EDU})^2 + .22204 \text{HEA} - .024017 (\text{HEA})^2$$

(22.106)	(2.8965)	(-2.2558)	(1.805)	(-2.4626)
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Adjusted R² = 75.8%

where, LNMU is natural log of urban real per capita income, EDU is real per capita expenditure on education and HEA is real per capita expenditure on health. The terms in bracket are t-ratios³. Similarly, for rural areas a double-log specification resulted in the following :

¹ The analysis can further be extended to other distribution sensitive measures of poverty and the results that come out remain consistent with those for the headcount ratio.

² For details see Ali. A. and E. Elbadawi (1999)

³ Appropriate tests for hetroskedasticity, normality and functional form have been made for all regression results reported in the paper and the results are satisfactory

$$(10) \dots \text{LMR} = 4.9751 + .71166 (\text{LEDU}) - .49547 (\text{LNHEL}) \quad \text{Adjusted } R^2 = 62\%$$

$$(17.52) \quad (4.23) \quad (-2.64)$$

where LMR is natural log of mean per capita income in rural areas, LEDU is natural log of per capita public expenditure on education, LNHEL is natural log of real per capita public expenditure on health.

Table 8: OLS Regression of per capita income on per capita education and health for a sample of African Countries under different functional specifications

No	Dep. Variable	$\overline{R^2}$	Cons.	Independent Variable					
				EDU	(EDU) ²	LNEDU	(LNEDU) ²	HEA	LNHEA
1									
2	MR	61	344.23 (4.38)	16.285 (3.276)					-29.79 (-1.8)
3		59	10.072 (.08)			284.25 (3.985)			-190.81 (-2.396)
4		60	227.60 (3.266)				53.601 (4.067)	-58.8 (-2.39)	
5	LMR	37	5.019 (13.74)			.3812 (2.63)			
6		42	4.978 (16.03)	.1026 (2.61)	-.0021 (-2.127)				
7	LMU	30	5.907 (15.64)			.3468 (2.317)			
8		41	5.905 (19.62)	.103 (2.721)	-.00217 (-2.295)				

Key to Variables: LMR-Natural log of per capita income in rural areas; MR-per capita income in rural areas; LMU-per capita income in urban areas; EDU-per capita expenditure on education; HEA-per capita expenditure on health; LNEDU-natural log of per capita expenditure on education; LNHEA-natural log of per capita expenditure on health. Figures in parenthesis are t-ratios.

42. The optimal reallocation rule has been applied to public expenditure on education and health separately. The regression equation with best statistical fit was used to generate the elasticities. Table (9) reports optimal allocation rule based on θ s generated from the following equations (see details in Table 8).

$$(11) \dots \text{LMU} = 5.9071 + .34681 \text{LNEDU} \quad \text{Adjusted } R^2 = 30, \quad n=11$$

$$(15.64) \quad (2.3169)$$

$$(12) \dots \text{LMR} = 5.0194 + .38121 \text{LN (EDU)} \quad \text{Adjusted } R^2 = 37, \quad n=11$$

$$(13.74) \quad (2.63)$$

Where, LMU and LMR stand respectively for the natural log of mean per capita income in urban and rural sectors, LNEDU is natural log of public expenditure on education and EDU is public expenditure on education⁴.

Table 9: Optimal Allocation of Public Expenditure on Education Between Rural and Urban Areas for selected African Countries:

Country	P_0^r (%)	$(1-\varepsilon^r)\eta^r$	β^r	θ^r	ϕ^r	P_0^u (%)	β^u	$(1-\varepsilon^u)\eta^u$	θ^u	ϕ^u	Optimal allocation Rule for rural areas	Optimal allocation Rule for urban areas
Burkina Faso	67.67	-0.528	0.84	0.3812	-11.4	44.16	0.16	-0.1504	0.346	-0.37	0.9683	0.0317
Central African Rep.	77.56	-0.527	0.62	0.3812	-9.7	49.73	0.38	-0.2302	0.346	-1.49	0.8667	0.1333
Cote d'Ivoire	36.72	-0.298	0.58	0.3812	-2.4	37.98	0.42	-0.2580	0.346	-1.44	0.6268	0.3732
Ethiopia	62.75	-0.501	0.85	0.3812	-10.2	52.90	0.15	-0.2850	0.346	-0.79	0.9282	0.0718
Gambia	45.41	-0.416	0.73	0.3812	-5.3	40.09	0.27	-0.1559	0.346	-0.59	0.8999	0.1001
Ghana	29.30	-0.217	0.69	0.3812	-1.7	30.69	0.31	-0.2034	0.346	-0.68	0.7094	0.2906
Guinea Bissau	71.79	-0.562	0.70	0.3812	-10.7	52.91	0.30	-0.4043	0.346	2.23	0.8280	0.1720
Kenya	39.44	-0.261	0.84	0.3812	-3.3	42.52	0.16	-0.3040	0.346	-0.70	0.8253	0.1747
Senegal	34.15	-0.292	0.61	0.3812	-2.3	34.94	0.39	-0.2616	0.346	-1.24	0.6503	0.3497
Zambia	74.09	-0.577	0.63	0.3812	-10.3	53.35	0.37	-0.3741	0.346	-2.55	0.9453	0.0547

Source: Own calculations based on information on distribution in African Development Indicators: 1998/99

43. Given the definition of the variables and parameters in section (II), the first order condition for optimal allocation of a given public expenditure between rural and urban sectors is guided by the level of poverty in each sector (P_0), the elasticity of poverty with respect to mean per capita income (η), the population share in each sector (β) and the elasticity of economic growth with respect to public expenditure on education in both sectors (θ). Columns 2-10 of Table no (9) provide estimates of these variables.

44. The last two columns of Table (9) give an estimate for each country the optimal allocation rule for public expenditure on education between rural and urban sectors. In all cases what we observe is an allocation rule in favor of the rural sector. We see that for countries like Burkina Faso, Ethiopia, Guinea-Bissau and Zambia, Central African Republic and Gambia more than 85% of public expenditure would have to be directed to households in rural sectors. Only in cases of Senegal and Cote d'Ivoire do we have an allocation around 65% to the rural sector. By and large therefore, the optimal allocation rule states that public expenditure on education would have to concentrate significantly more on rural sector than the urban sectors in Africa if public expenditure programs have to make significant impact on poverty. This result is robust with respect to alternative specifications of the estimation of elasticity of public expenditure on education with respect to growth.

45. Table (10) below also reports results based on elasticity of public expenditure on income using the semi-log specifications for urban and rural areas⁵. It is shown here also that the reallocation rule is very much towards rural areas, reinforcing results in Table (9). The minimum allocation rule is for Cote d'Ivoire with 58%, followed by Senegal with 64% of total education expenditure going to rural areas. For the rest of the countries in the sample, more than 75% of public expenditure is required to be spent in rural areas to promote the objective of reducing poverty through expansion of education services.

⁵ The regression equations are:

$$LMU = 5.9052 + .10349(EDU) - .002178(EDU)^2 \quad \text{Adjusted } R^2 = 41\%$$

(19.62) (2.72) (-2.295)

$$LMR = 4.978 + .068(EDU) - .001(EDU)^2 \quad \text{Adjusted } R^2 = 34\%$$

(16.2) (1.72) (-1.1)

where LMPR is per capita income among the poor in rural areas.

46. The implications of the results in Table (9) and as well as in Table (10) to the direction of human development in general and the international development goals alluded to in preceding sections is straight forward. In Africa, the rural sector needs to receive more attention and higher share of public expenditure on education in order to speed up the pace of poverty reduction. This would entail increased literacy and enrollment rates at a faster rate than in urban sectors with the accompanying opportunities to participate in the labor market and judicious use of natural resources.

47. To get a feel of the pattern of public expenditure reallocation for health, we report in Table (10) the optimal proportion between rural and urban areas based on the values of θ generated from regression equations fitted between per capita expenditure of the poor in rural and urban areas and per capita expenditure on education and health. The estimated regressions from which the θ s are calculated are reported in equations (13) and (14):

$$(13) \dots \text{LMPR} = 4.8314 + .13731 (\text{LNEDU})^2 - .17006 (\text{LNHEA})^2 \quad \text{Adjusted } R^2 = 58\%$$

$$(27.24) \quad (4.09) \quad (-2.7186)$$

$$(14) \dots \text{LMPU} = 5.4243 + .11944 (\text{LNEDU})^2 - .12774 (\text{LNHEA})^2 \quad \text{Adjusted } R^2 = 43\%$$

$$(26.36) \quad (3.069) \quad (-1.7606)$$

where, LMPR and LMPU, respectively stand for natural log of mean per capita income of the poor in rural areas and urban areas. The rest of the variables are as defined above.

Table (10): Optimal Allocation of Public Expenditure on Health Between Rural and Urban Areas for selected African Countries:

Country	P_0^r (%)	β_1	β_2	β_3	P_0^u (%)	β_4	β_5	β_6	β_7	β_8	Optimal allocation Rule for rural areas	Optimal allocation Rule for urban areas
Burkina Faso	67.67	-0.528	0.84	-1.41	42.3	44.16	0.16	-0.1504	-1.06	1.1	0.99	0.01
Central African Rep.	77.56	-0.527	0.62	-3.65	93.1	49.73	0.38	-0.2302	-0.82	3.5	0.98	0.02
Cote d'Ivoire	36.72	-0.298	0.58	-5.59	35.3	37.98	0.42	-0.2580	-1.25	5.2	0.90	0.10
Ethiopia	62.75	-0.501	0.85	-5.35	142.9	52.90	0.15	-0.2850	-1.20	2.7	1.00	0.00
Gambia	45.41	-0.416	0.73	-2.34	32.2	40.09	0.27	-0.1559	-0.52	0.9	0.99	0.01
Ghana	29.30	-0.217	0.69	-5.02	21.9	30.69	0.31	-0.2034	-1.12	2.2	0.96	0.04
Guinea Bissau	71.79	-0.562	0.70	-0.99	28.0	52.91	0.30	0.4043	-0.22	1.4	0.98	0.02
Kenya	39.44	-0.261	0.84	-6.08	52.8	42.52	0.16	-0.3040	-1.36	2.7	0.99	0.01
Senegal	34.15	-0.292	0.61	-4.11	24.9	34.94	0.39	-0.2616	-0.92	3.3	0.92	0.08
Zambia	74.09	-0.577	0.63	-5.13	138.4	53.35	0.37	-0.3741	-1.15	8.4	0.97	0.03

Source: Own calculations based on information on distribution in African Development Indicators:1998/99

48. The results show the bulk of public expenditure on health should be directed to the rural sector. The result is consistent with the optimal allocation rule for education and is much more suggestive in reallocating the bulk of public resources to rural areas. The minimum percentage here is 92% for Senegal. For others the range is between 96-100%.

VI. Summary and Conclusions

49. The paper has shown that as Africa enters the 21st century, it boasts a massive incidence of poverty of around 52%. Looked at the level of sectors, the rural economy accounts for 81% of poverty in Africa, 75% of total population with a literacy rate of mere 36% and little access to clean water and sanitation. As we look forward to the Global Development Goals, Africa is confronted with the formidable challenge of reducing poverty by half, attaining universal primary education and reducing child mortality by one third. In this context, the role of public expenditure on education and health and the allocation pattern plays a pivotal role in realizing these objectives. It is noted that resources allocated to education and health on the average in Sub-Saharan Africa amounted to, respectively 3.64 and 1.66 percent of GDP, or a real per capita expenditure of \$13.99 and \$5.91 in 1998.

50. Given the meager resources available to promote and sustain human development in Africa, the question of public expenditure reallocation deserve serious considerations. This paper has developed and applied a method of public expenditure reallocation with the objective of minimizing poverty in the continent. A preliminary result applied to public expenditure on education has shown that the bulk of it should go to the rural sector if the objective of the government is to minimize poverty at each level of expenditure. The link between public expenditure and poverty has been established through the link between education and economic growth and in turn between economic growth and poverty. Even though, actual figures are lacking, the current allocation of public expenditure on education in most African countries (and in fact elsewhere too) tend to be urban-biased if one looks at the size of public education facilities and enrollment rates at various levels. The results in this paper are based on consideration of efficiency of public expenditure in promoting economic growth and in turn growth in reducing poverty.

References

- Ali, A.A.G., (1999), "dealing with poverty and inequality"; draft, ESPD, ECA, Addis Ababa.
- Ali, A.A.G. and E. Elbadawi, (1999), Inequality and Dynamics of Poverty and Growth, paper prepared for presentation at the launch workshop of AERC collaborative Project on "Explaining Economic Growth Performance in SSA", Harvard.
- Atkinson, A.B., (1998), Poverty in Europe; Blackwell Publishers, Oxford.
- ECA, (1999), Economic Report on Africa 1999; Addis Ababa, Ethiopia.
- Griffin, K. and T. McKinley, (1994), Implementing a Human Development Strategy; Macmillan, London.
- Gupta, S., Honjo, K. and M. Verhoeven, (1997), "the efficiency of government expenditure: experiences from Africa"; IMF Working Paper WP/97/153, Washington D.C.
- Mkandawire, T. and C. Soludo, (1999), Our Continent, Our Future: African Perspectives on Structural Adjustment; CODESRIA, Dakar.
- World Bank, (1999a), African Development Indicators; Washington D.C.
- World Bank (1999b), Special Program of Assistance, various issues

Annex Table (A-1): Estimates of Poverty Incidence, Depth and Severity in Rural and Urban Areas for Selected African Countries (%)

Country	Rural			Urban		
	P0	P1	P2	P0	P1	P2
Burkina Faso	67.67	26.2	12.78	44.16	17.59	9.16
Central African Rep.	77.56	45.72	31.97	49.73	24.16	15.42
Cote d'Ivoire	36.72	9.9	3.55	37.98	11.04	4.33
Djibouti	71.1	31.45	18	45.40	15.53	7.11
Ethiopia	62.75	21.23	9.39	52.90	19.71	9.56
Gambia	45.41	17.71	9.61	40.09	13.59	6.25
Ghana	29.3	6.01	1.8	30.69	8.22	2.95
Guinea	60.51	21.99	10.29	43.52	14.24	6.37
Guinea Bissau	71.79	43.18	31.27	52.91	24.27	14.76
Kenya	39.44	15.5	8.64	42.52	16.04	8.05
Madagascar	54.25	21.1	10.89	45.09	17.39	8.75
Mali	62.47	25.67	13.53	41.33	13.81	6.43
Mauritania	40.25	13.26	6.05	30.12	8.43	3.43
Niger	65.05	37.08	26.02	41.60	15.56	8.05
Nigeria	48.23	19.8	10.92	34.72	11.69	5.49
Senegal	34.15	9	3.61	34.94	8.64	2.94
South Africa	51.53	19.49	9.74	29.51	11.11	5.35
Swaziland	58.84	28.14	17.41	58.58	33.07	22.71
Tanzania	65.37	25.01	12.34	49.58	16.93	7.67
Uganda	50.6	17.7	8.36	44.84	15.85	7.59
Zambia	74.09	36.67	22.25	53.35	21.61	11.46
Mean	55.58	23.42	13.26	43.03	16.12	8.28
Standard Dev.	14.14	10.77	8.47	8.41	6.87	5.59

Source: Calculations based on World Bank, African Development Indicators:1998/99

Annex Table (A.2): Expenditure on Education and Health as a Percentage of GDP in a Sample of African Countries

No.	Country	Year	Expenditure on Education	Expenditure on Health	1998 Population (in Million)
1	Benin	1999	2.9	1.3	5.88
2	Burkina Faso	1998	3.8	2.6	11.4
3	Burundi	1999	0.9	0.2	6.59
4	CAR	1999	3.0	2.4	3.49
5	Comoros	1999	4.8	2.4	0.67
6	Cote d'Ivoire	1999	5.1	1.3	14.57
7	Eritrea	1997	5.1	2.9	3.55
8	Ethiopia	1999	3.8	1.7	62.11
9	Gambia	1999	3.0	1.9	1.19
10	Ghana	1998	3.8	1.2	18.86
11	Guinea Bissau	1999	1.8	0.9	1.14
12	Kenya	1999	6.7	2.0	29.02
13	Malawi	1999	4.8	2.4	10.38
14	Mozambique	1999	2.5	1.2	18.69
15	Senegal	1999	3.7	0.8	9
17	Uganda	1999	3.2	0.8	21.32
18	Zambia	1999	3.0	2.2	8.69
	Total				226.55
	Simple Average		3.6	1.7	
	Weighted Average		3.99	1.58	
	Maximum		6.7	2.9	62.1
	Minimum		0.9	0.2	0.7
	S.Deviation		1.4	0.8	14.9

Annex Table (A.3): Expenditure on Education and Health for a Sample of African Countries (in 1997 current prices)

Expenditure on Education at

No.	Country	Year	Expenditure on Education (% GDP)	Expenditure on Health (% GDP)	Actual Current Expenditure on Education (Million \$)	Actual Current Expenditure on Health (Million \$)	1997 Current GDP (Million \$)	1998 Population (in Million)	Expenditure on Education Per Capita (current)	Expenditure on Health Per Capita (Current)	SAP of the Year	Expenditure on Education Per SAP (current \$)	Expenditure on Health Per SAP (Current \$)	#	Country	Year	Expenditure
1	Benin	1999	2.9	1.3	61.96	27.78	2136.7	5.88	10.54	4.72	1508365	18.42	1	Benin		1999	
2	Burkina Faso	1998	3.8	2.6	92.78	63.48	2441.5	11.4	8.14	5.57	2861680	22.18	2	Burkina Faso		1998	
3	Burundi	1999	0.9	0.2	11.14	2.47	1237.3	6.59	1.69	0.38	1692186	1.46	3	Burundi		1999	
4	CAR	1999	3	2.4	30.56	24.45	1018.8	3.49	8.76	7.01	844328	28.96	4	CAR		1999	
5	Comoros	1999	4.8	2.4	9.29	4.64	193.5	0.67	13.86	6.93	160123	29.00	5	Comoros		1999	
6	Cote d'Ivoire	1999	5.1	1.3	522.82	133.27	10251.4	14.57	35.88	9.15	3602798	36.99	6	Cote d'Ivoire		1999	
7	Eritrea	1997	5.1	2.9	32.78	18.64	642.7	3.55	9.23	5.25	830112	22.45	7	Eritrea		1997	
8	Ethiopia	1999	3.8	1.7	242.49	108.48	6381.2	62.11	3.90	1.75	15206135	7.13	8	Ethiopia		1999	
9	Gambia	1999	3	1.9	12.22	7.74	407.3	1.19	10.27	6.50	271796	28.47	9	Gambia		1999	
10	Ghana	1998	3.8	1.2	256.95	81.14	6761.9	18.86	13.62	4.30	4617436	17.57	10	Ghana		1998	
11	Guinea Bissau	1999	1.8	0.9	4.78	2.39	265.4	1.14	4.19	2.10	270584	8.83	11	Guinea Bissau		1999	
12	Kenya	1999	6.7	2	686.09	204.80	10240.2	29.02	23.64	7.06	7461020	27.45	12	Kenya		1999	
13	Malawi	1999	4.8	2.4	116.33	58.16	2423.5	10.38	11.21	5.60	2687524	21.64	13	Malawi		1999	
14	Mozambique	1999	2.5	1.2	68.82	33.03	2752.6	18.69	3.68	1.77	4628103	7.14	14	Mozambique		1999	
15	Senegal	1999	3.7	0.8	168.50	36.43	4554.1	9	18.72	4.05	2254961	16.16	15	Senegal		1999	
16	Uganda	1999	3.2	0.8	210.26	52.56	6570.6	21.32	9.86	2.47	5486870	9.58	16	Uganda		1999	
17	Zambia	1999	3	2.2	121.54	89.13	4051.4	8.69	13.99	10.26	2340449	38.08	17	Zambia		1999	
	Total						62330.1	226.55			56724469			Total			
	Simple Average		3.64	1.66	155.84	55.80	3666.48	13.33	11.83	4.99	3336733	20.09		Simple Average			
	Weighted Average Based on 1997 Current GDP		4.25	1.52						4.19		46.70		Weighted Average Based on 1998 GDP			
	Maximum		6.70	2.90	686.09	204.80	10251.40	62.11	35.88	10.26	15206135	38.08		Maximum			
	Minimum		0.90	0.20	4.78	2.39	193.50	0.67	1.69	0.38	160123	1.46		Minimum			
	S. Deviation		1.38	0.77	189.82	54.47	3311.18	14.90	8.31	2.72	3675363.7	10.75		S. Deviation			

Annex Table (A.4): Intrasectoral Allocation of Education Expenditure in Selected African Countries
(percent of total)

#	Country	Year	Primary Education	Secondary Education	Primary & Secondary Education	Tertiary Education	Other
1	Burundi	1993	44.0	25.0	69.0	23.0	8.0
2	CAR	1992	56.0	16.0	72.0	23.0	5.0
3	Cote d'Ivoire	1995	48.6	33.5	82.1	17.8	0.0
4	Ethiopia	1992-93	45.0	24.0	69.0	13.0	18.0
5	Ghana	1992	41.5	43.2	84.7	15.3	0.0
6	Guinea	1992	42.0	25.0	67.0	33.0	0.0
7	Guinea Bissau	1992	54.3	11.4	65.7	5.5	28.8
8	Kenya	1992-93	60.0	17.0	77.0	17.0	6.0
9	Lesotho	1991-92	52.0	30.0	82.0	15.0	3.0
10	Madagascar	1993	44.9	29.9	74.8	25.2	0.0
11	Mozambique	1990	50.0	35.6	85.6	14.4	0.0
12	Niger	1992	42.0	25.0	67.0	22.0	11.0
13	Senegal	1991	48.9	25.5	74.4	25.5	0.0
14	Sierra Leone	1991	38.6	22.6	61.2	29.6	9.2
15	Tanzania	1993-94	52.0	13.0	65.0	35.0	0.0
16	Togo	1995	41.0	16.0	57.0	25.0	18.0
17	Zambia	1994	46.1	12.1	58.2	11.5	30.6
18	Zimbabwe	1990	49.3	30.6	79.9	20.2	0.0
	Mean		47.6	24.2	71.8	20.6	7.6
	S.Deviation		5.8	8.8	8.9	7.7	10.0
	Maximum		60.0	43.2	85.6	35.0	30.6
	Minimum		38.6	11.4	57.0	5.5	0.0

Source: Gupta, Honjo and Verhoeven (1997)