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The External Debt-Servicing Constraint and Public Expenditure Composition

Evidence from African Economies

Augustin Kwasi Fosu*

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Abstract

The paper explores the impact of a binding external debt-servicing constraint on the sectoral composition of government expenditures in the economies of Africa, where this constraint has traditionally been most prevalent. Applying seemingly unrelated regression (SUR) to 1975-94 five-year panel data for 35 countries, the paper finds that the implied debt service burden adversely affects the share of public spending in the social sector, with similar impacts on education and health. Despite evidence that such a burden might also negatively influence public investment, the deleterious implications of debt servicing appear to be primarily a social-sector phenomenon. The partial elasticity on the sector's expenditure share is estimated at 1.5, which is by far the highest among all the explanatory variables considered, including external aid, whose estimated effect on the social sector is positive but with an elasticity of only 0.2. Aid also positively affects public investment with a similar elasticity of 0.2. Constraint on the executive exercises significant positive and negative impacts, respectively, on

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Keywords: external debt servicing, public expenditure composition, seemingly unrelated regression, African economies

JEL classification: F34, H50

* UNU-WIDER, Helsinki, email: fosu@wider.unu.edu

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capital and agricultural spending, and also appears to positively influence health expenditure. In addition, expenditures in the social sector have been tending upward, despite the structural adjustment programmes of the 1980s, and even prior to the Highly Indebted Poor Countries (HIPC) Initiatives that have tended to emphasize spending in the social sector.

Acronyms

GNP gross national product

HIPCs highly indebted poor countries

ODA official development assistance

SUM seemingly unrelated regression

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

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1 Introduction

While external debt-servicing difficulties have afflicted many countries in the developing world, the challenge has been particularly great for African economies. Most of these economies have not been able to generate the requisite resources to meet repayment obligations especially since the early 1980s (Greene 1989). There is, however, a large cross-country variance in both the debt service rate and arrears, suggesting disparities in the liquidity-constraint situation among African countries. In 1998, for instance, just prior to the 1999 Highly Indebted Poor Countries (HIPC) Initiative, the debt service rate ranged from 1 per cent or less in the Democratic Republic of Congo and Eritrea to 30 per cent or more in Angola and Zimbabwe. Similarly, arrears as a proportion of total debt stocks, further reflective of debt-burden differences, varied from 1 per cent or less in Botswana, Eritrea, Gambia, Ghana, Mauritius, Senegal, Swaziland and Zimbabwe, to 56 per cent in Ethiopia, 59 per cent in Nigeria, 67 per cent in the Democratic Republic of Congo, 68 per cent in Somalia, 78 per cent in Liberia, and 80 per cent in Sudan (World Bank 1999).

The deleterious impact of debt constraints on growth has been noted for developing countries generally and for African countries in particular (e.g., Clements, Bhattacharya and Nguyen 2003; Cohen 1993; Elbadawi, Ndulu and Ndungu 1997; Fosu 1996, 1999; Greene 1989; Pattillo, Poirson and Ricci 2002). The basis of the growth impact of debt servicing might be attributable, in part, to the diminution of government expenditure resulting from debt-induced liquidity constraints (Taylor 1993). In this paper, we explore how this liquidity constraint might have influenced the composition of public spending with respect to the functional sectors of government. For example, might effective debt-servicing requirements shift the budget away from the social sector or public investment? This is an important issue, for public expenditures are likely to be a salient determinant of the economic activities in many functional sectors. For example, government spending is dominant in the education and health sectors, while public investment in infrastructure is a key to determining productive private investment. To what extent, then, might fiscal constraints posed by debt servicing affect the fiscal allocation in the developing countries of Africa?

A number of studies have examined the relationship between government spending and revenues in developing countries (Bleaney, Gemmell and Greenaway 1995; Lim 1983), while others focus on the determinants of government expenditures (Dao 1995; Fielding 1997). However, much of the emphasis in the literature on the fiscal implications of external inflows in low-income developing countries has been on the role of external aid rather than of debt (Cashel-Cordo and Craig 1990; Devarajan, Rajkumar and Swaroop 1998; Feyzioglu, Swaroop and Zhu 1998; Gang and Khan 1990; Gbesemete and Gerdtham 1992; Ouattara 2006). Such a focus reflects the historical importance of aid relative to debt in low-income developing countries generally and African economies in particular. Nevertheless, a significant portion of aid is tied to loans and, therefore, to the accumulation of external debt. Isolating the debt impact is, therefore, an important objective in its own right. However, existing studies generally do not emphasize this objective.

The few studies that estimate the external debt impact on fiscal allocation include Cashel-Cordo and Craig (1990). Although the authors focus on the impact of aid, they include debt service among the variables explaining government expenditures and revenues. They find a negative effect of debt service on total government spending;

however, with the exception of defence, the study does not disaggregate public expenditure. Mahdavi (2004) deals specifically with the impact of external debt on the composition of government spending, but disaggregates public expenditure into: (i) wages and salaries of public employees, (ii) non-wage purchases of goods and services, (iii) interest payments, subsidies and other current transfers, and (iv) other (residual) economic categories. While such categorization is useful, it does not shed light on expenditure in the functional sectors such as the social sector (health and education), economic services, public investment, and agriculture.[1] Yet, it is such functional spending that may convey information about the social 'preference'. For example, to what extent would government shift expenditure to or from the social sector or public investment in response to a debt service burden? An answer to this question is important, for it can provide information on whether such fiscal action is consistent with the expectations of debt relief. For instance, as part of the initiative on HIPCs, it was anticipated that a significant portion of debt relief would be channelled into the social sector.

Evidence on the impact of debt on the composition of functional-sector expenditures is scant. One possible exception is Ouattara (2006), which reports estimates of debt-servicing impacts on sector expenditures, though the paper's main objective was to assess the effects of external aid. Based on observed debt servicing, the study finds, for example, that the debt effect on social sector spending was insignificant. In contrast, Fosu (2007) finds that the effect of debt servicing on education expenditure is strongly negative once one appropriately measures the burden of debt servicing. That study does not, however, shed light on expenditures for the other functional sectors. The present study attempts to fill that gap.

The section immediately following this introduction presents a simple theoretical framework for the debt-expenditure relationship. Based on the framework, section 3 specifies an empirical model. The sample and data are described in section 4; section 5 estimates the empirical model, which is followed by the summary and conclusion in the final section.

2 Theoretical framework

This section presents a simple static theoretical model as a framework for the subsequent empirical estimation of the debt-expenditures relationship. The government is assumed to choose the level of expenditures for each functional sector j, G^j, in order to maximize a social welfare function, U. Unlike the usual individual utility function, however, the functional arguments are in the expenditure form rather than quantities of commodities per se. The underlying assumption, then, is that public spending provides consumable services to the citizenry and thus utility to society. In the public choice literature, government officials would seek to maximize the probability of being maintained in office, and would make choices consistent with the preferences of the median voter (Buchanan 1989; Tullock 1971). The median-voter model is probably unsuitable for developing countries, though, where the democratic process is rarely

[1] Actually, Mahdavi (2004) instead employs the (relative) spending on the functional sectors as explanatory variables.

operational. Instead, the social welfare function is likely to entail a weighted average of various political coalitions in the country. In the current analysis, therefore, a more generic social welfare function is presumed, with the government maximizing, for J sectors:

$$U\ (G^1, G^2,\ldots,G^J), \tag{1}$$

subject to the budget constraint

$$\Sigma_j G^j = R, \tag{2}$$

where R denotes government revenue, which may be expressed as

$$R = T + N + A - D, \tag{3}$$

where T is tax revenue, N is domestic non-tax revenue, A is external aid, and D is debt service. With U_j the marginal 'utility' (marginal change in the social welfare function) of expenditure on sector j, the first-order conditions are:

$$U_1 = U_2 = ...= U_J \tag{4}$$

$$\Sigma_j G^j = R = T + N + A - D \tag{5}$$

If the social welfare function has the usual properties of strict quasi-concavity, then the second-order conditions are satisfied, and we can employ the implicit function theorem to write the demand functions:

$$G^j = G^j(R^X) \tag{6}$$

where R^X is the exogenous component of R.

Explored now is the response of expenditure in sector j to changes in revenue, R, and particularly the change in G^j following a marginal change in debt service, D. Assuming that a given sector commodity j is a normal good then $G_{jR} > 0$, where G_{jR} is the partial effect of R^X on G^j. Furthermore, from equation (5), the partial effect of D on R, $R_D < 0$. Using the chain rule, then, the partial effect of debt on the j sector expenditure, $G_{jD} < 0$ (that is, $G_{jD} = G_{jR}R_D$). Hence, for all sectors considered as 'normal' we would expect an increase in debt servicing, via its reduction of revenue, to reduce their respective expenditures. The degree to which that occurs depends on the strength of the income effect, however.

Since we are interested in the relative fiscal responses of the various sectors, a pertinent question is: how would expenditure *shares* change for a given increase in D? The answer would depend on the Engel properties of the sector. For example, beyond some basic levels the social sector might be viewed as 'luxury' relative to the other sectors. Hence, a reduction in R attributable to an increase in D may lead to a shift of expenditures away from this sector, especially if other government spending in the non-social sectors is relatively fixed by the political process. Strictly speaking, though, since

the Engel properties are not precisely known for the various sectors, it is an empirical question as to the nature of each sector's response.

3 The empirical model

An appropriate specification of equation (6) would involve the institutional framework for government decisionmaking, suggesting the desirability of a structural model (Shepsle 1979). For example, Heller (1975) and Mosley, Hudson and Hornell (1987) apply structural equations to the examination of the implications of external aid for developing countries. In such models, domestic resources are endogenized. For example, Devarajan, Rajkumar and Swaroop (1998) estimate a domestic resource equation and augment the expenditure model with the residuals. Other authors apply instrumental estimation to the revenue equation and include the predicted revenue in the expenditure model. Choosing appropriate instruments can, however, be difficult. For instance, Fielding (1997) employs in the revenue equation the following instrument: the value of imports as a proportion of nominal GDP. It is unclear, though, as to how well this variable serves as an appropriate instrument, given that imports themselves are likely to be endogenous with respect to revenues.

As is well known in the literature, the estimation of structural models can be very sensitive to the nature of their specification. Furthermore, the process of scrutinizing government budgetary decisions is not well understood, especially in developing countries where political processes are rarely embedded in a democratic framework. The available structural models, therefore, all have non-trivial problems (Inman 1979). Consequently, several studies have relied on reduced-form specifications (e.g., Cashel-Cordo and Craig 1990; Feyzioglu, Swaroop and Zhu 1998). Results from these models can be relatively robust across different types of public choice mechanisms (Craig and Inman 1986). Based on equation (6), therefore, we adopt here a reduced-form model:

$$g^j = g^j(D^X, F, Q, A, P, T, u_j),\ j=1,2,\ldots,J \qquad (7^j)$$

where g^j measures the share of government expenditure in sector j; D^X is the exogenous component of external debt service;[2] F is foreign aid, defined as official development assistance (ODA) as a proportion of GDP; Q is income, measured as gross national product (GNP) per capita; A is the share of the population engaged in agriculture; P is the political structure, measured by the degree of constraint on the executive organ of the government; T is the set of time-period dummy variables intended to reflect intertemporal trends; and u is the stochastic disturbance term. The focus of the current paper, though, is on the debt variable, with the other variables serving control factors.

The functional arguments in the above set of reduced-form equations (7^j): D^X, F, Q, A, P and T are assumed to be exogenous.[3] Regarding the main variable of interest, if debt servicing reflects, on the one hand, past borrowing decisions with borrowers honouring

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2 As argued below, debt servicing is endogenous to government action and only the exogenous component should be included in the reduced-form model.

3 Note, in particular, that domestic revenue is considered endogenous and is therefore excluded from the reduced-form equation (7).

previously established contracts, then D would be exogenous (Cashel-Cordo and Craig 1990). On the other hand, if governments are able to decide how much of the debt obligations to honour, then D becomes endogenous. The degree of endogeneity would depend on the size of the penalty governing default, relative to the shadow price of debt servicing. Where such a penalty is sufficiently high, this potential problem is minimized. Realistically, though, governments have some latitude in rescheduling debts in order to lower their current debt payments. Indeed, the historic existence of debt arrears in many SSA countries suggests that actual debt payments seldom conform to schedule. Observed debt payments are unlikely, therefore, to reflect their required debt-servicing requirements. Hence, the exogenous component of debt servicing, D^X, is the relevant debt variable in the reduced-form expenditure equation. As argued above, the expected sign of the coefficient of the debt variable for a given sector's expenditure share would depend on the respective Engel properties. However, the social sector may be particularly vulnerable to a binding debt-servicing constraint, as governments may view its product as a 'luxury', relative to that of the non-social sector. If so, then we should expect a negative effect of D^X on g^j.

Discussed now are the remaining variables in the set of equations (7^j). Consistent with other studies (e.g., Cashel-Cordo and Craig 1990; Devarajan, Rajkumar and Swaroop 1998; Feyzioglu, Swaroop and Zhu 1998; Gang and Khan 1990; Gbesemete and Gerdtham 1992; Ouattara 2006), F is included to capture the special role of ODA in the budget process. In general, the impact of foreign aid will be contingent on the relative degree of its fungibility. A higher ODA level should increase revenue and, hence, expenditure in every 'normal' sector. Whether a given expenditure share increases or not in response to ODA, however, depends on the nature and extent of the effective conditionality placed on the aid. Detailed data on sector aid are seldom available, though.[4] Besides, given sufficient fungibility, disaggregating external aid may not be consequential either. For example, Fosu (2007) finds that education-specific ODA is extraneous in the education expenditure equation. To the extent that it reflects donors' preferences, however, external aid is unlikely to exert a neutral impact on the composition of expenditures. For example, there has been the tendency for donors to traditionally favour the social sector. If so, then an increment in ODA should shift the budget toward that sector. Nonetheless, the existence of ODA fungibility is likely to reduce the aid impact even if it is positive.

There is also the question of the possible endogeneity of aid. As long as it reflects donors', rather than recipients', preferences independent of the budgetary process, ODA should be exogenous. Although aid administered as 'budget support' may be influenced by the recipient's budget, the 1975-94 sample period employed for the present study precedes this particular innovation. Besides, to the extent that external aid is not affected by the *composition* of the budget, the use of expenditure shares, rather than levels, as dependent variables should help minimize any possibility that ODA is endogenous.

Consistent with preference aggregation, socioeconomic characteristics such as income and the level of development may shape the government's social welfare function and,

4 For example, ODA data for data are unavailable for most of the countries in the sample until 1990 (see the OECD data source, available at: www.oecd.org/dac/stats/idsonline).

hence, the sector expenditures.[5] Including socioeconomic variables in the expenditure model, though, has shown these variables to be generally inconsequential for overall government expenditures (Cashel-Cordo and Craig 1990), for education (Fosu 2007), and for health (Gbesemete and Gerdtham 1992). Nonetheless, Q and A are included in the regression as control variables, for their respective effects might be sector-specific.[6]

The political structure, indicated by P, is likely to influence societal allocation of expenditures (Fardmanesh and Habibi 2000; Gupta et al. 2002; Habibi 1994; Mauro 1998; Tanzi and Davoodi 1997). In particular, corruption has been observed to constitute a salient variable in the expenditure equation, with the tendency to shift spending away from the social sector (Goel and Nelson 1998; Gupta, Davoodi and Tiogson 2000; Gupta, de Mello and Sharan 2001; Mauro 1998), and toward the capital sector (Tanzi and Davoodi 1997). However, as corruption data do not sufficiently extend to the earlier period for most countries in our sample over the 1975-94 period, we employ here XCONST, measuring the degree of constraint to the executive branch of government (Marshall and Jaggers 2002). It is expected that a higher level of XCONST would reduce corruption and thus shift the budget away from particularly the capital sector.

The set of time dummy variables, T, is included as explanatory variables to reflect global trends, or internal intertemporal factors not sufficiently captured in the existing independent variables. For example, T may pick up time-variant trends such as the possibility of externally driven increasing emphasis over time on the importance of the social sector even prior to the HIPC Initiative. The inclusion of T in the regression will also help to test the hypothesis that African countries have been reducing their social-sector spending over time, especially in response to structural adjustment of the 1980s.

4 Sample and data

The sample consists of 35 Sub-Saharan African countries (Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Uganda, Zaire, Zambia and Zimbabwe). The sample period is 1975-94, based on the availability of comparable data, especially on functional sector expenditures (source: World Bank 1992, 1996, 1998-99). While more recent expenditure data are available for a number of these countries (see, for example, World Bank 2004), they are not strictly comparable with those from previous sources. Unfortunately, the data from this more recent source contain only sporadic relevant statistics for previous years, so that panel-data estimation could not appropriately be conducted beyond 1994. Thus, results from the present study should be viewed in historical context, as they predate the HIPC Initiatives of the late 1990s that seemed to put emphasis on the social

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5 For the importance of these variables toward the social sector spending, see for instance (Baqir 2002).

6 For example, we included in the expenditure equations the share of the population under 14 years of age, which represented the age structure; however, as this variable was observed to be extraneous, it was dropped. Fosu (2007) and (Gbesemete and Gerdtham 1992) obtained a similar result in the cases of education and health, respectively.

sector for channelling the savings from debt relief. Furthermore, that the data precede these initiatives suggests actually that results from the study will not be biased by the initiatives themselves and can, therefore, be used to reliably assess the extent to which the above HIPC objective is consistent with the 'preferences' of the recipients of debt relief.

4.1 Composition of public expenditures

Fiscal allocation varies considerably across budget categories in the developing countries of Africa. Over the 1975-94 sample period, the social sector (education plus health) averaged about 20 per cent of the total public budget, compared with nearly 30 per cent for capital, one-quarter for economic services, and roughly 10 per cent each for public investment and agriculture. Yet, there were also differences across countries and over time. For example, public expenditure for the social sector ranged from less than 10 per cent of the total budget in the Sudan and Nigeria to nearly 30 per cent in Benin and Ghana; from below 10 per cent in Zimbabwe to over 40 per cent in Burundi and Chad for capital; from 11 per cent in Mali to 40 per cent in the Sudan for economic services; from less than 5 per cent in the Congo, Ivory Coast and Zaire (DRC) to over 20 per cent in Chad for agriculture; and from below 5 per cent in Senegal and Zaire to over 30 per cent in Lesotho in the case of public investment.[7]

Intertemporal public expenditure differences have not been as dramatic, though. Reported in Figure 1 are graphs of expenditure shares by sector based on panel averages for the four half-decadal sub-periods, 1975-79, 1980-84, 1985-89, and 1990-94. For SSA as a whole, the share of the public budget allocated to the social sector increased from 20 per cent in 1975-79 to 23 per cent in 1990-94, and 25 per cent to 26 per cent for capital; meanwhile, the share of the budget allocation for agriculture decreased only slightly from 9 per cent to 8 per cent, but rather considerably for the economic-services and public-investment sectors, from 26 per cent to 19 per cent and from 15 per cent to just 8 per cent, respectively.

It is interesting to note, then, that trends in the shares of social spending are not downward; the expenditure shares for capital and agriculture have not changed very much, though there was a considerable dip in the latter during the early 1980s but with a recovery immediately thereafter; however, the expenditure shares for economic services and public investment indicate considerable trends downward. The preliminary evidence, therefore, seems to indicate that on the whole the priorities of African countries have not been diverted away from the social sector over time, even following the structural adjustment programmes of the 1980s and prior to the HIPC initiatives of the latter part of the 1990s, contrary to the popular view.[8]

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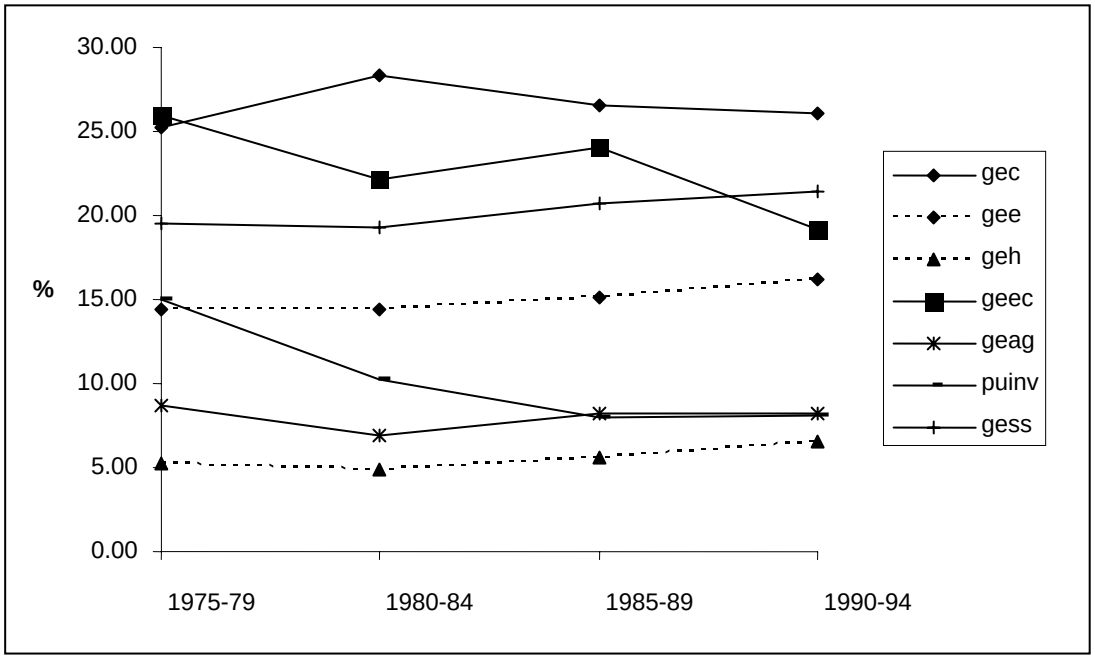
7 Note that while the data are, by and large, for the entire 1975-94 sample period used in the present study, others are for only certain sub-periods (1975-79, 1980-84, 1985-89, or 1990-94) due to missing data. The only point we wish to illustrate currently is that there are considerable disparities across countries within the 1975-94 period of analysis.

8 See, for example, Cogan (2002).

Figure 1
Trends in sectoral expenditure shares in Africa, 1975-94



Note: Non-weighted means of country expenditure shares. See Table 1 for the variables' definitions and data sources.

Figure 2
Trends in real expenditures on the social sector in Africa, 1975-94

Notes: Non-weighted means of country per capita expenditures, in 1987 US dollars; *geepcp*, *gehpcp* and *gesspcp* are real per capita expenditures on education, health and social sector (education and health), respectively. Data sources are the same as those for GEE, GEH and GESS (see Table 1).

In addition to expenditure shares, have the actual *real* expenditures per capita also trended upward for the social sector? Figure 2 sheds some light on this question.[9] As the graphs show, real per capita expenditures in the sector have also been increasing over time, and more so for health than educational expenditures. This result is consistent with that provided in Sahn (1992) based on the author's 1980-89 sample period showing generally non-declining trends in social-sector spending in Africa. The present result from a longer sample period appears to support Sahn's earlier finding. Furthermore, that the current sample includes 1990-94 is especially meaningful, given that by 1989 many African countries were still undergoing structural adjustments, so that 1990-94, rather than 1985-89, could be characterized as post-adjustment.

4.2 The debt-servicing variable

The main explanatory variable of interest deserves special attention. As discussed above, debt servicing is likely to be endogenous in the sense that a country with pressing needs for other government expenditures may adjust its debt servicing accordingly. Actual debt service payments, therefore, would likely reflect the country's ability and, indeed its willingness to pay as well,[10] and might not serve as a reliable indicator of the debt burden. While debt service expenditure could also be lower for a given debt stock due to greater concessionality, this situation should reasonably be captured as a higher ODA. Thus, the actual debt service payment may not reflect the degree of the liquidity constraint (Fosu 1999). So to obtain a more appropriate measure of debt servicing, a 'predicted' debt service is obtained by regressing actual debt service on 'net debt', defined as the debt stock less international reserves. Net debt is, thus, considered as the best indicator of the external debt burden (ibid.), and the predicted debt service ratio is intended to reflect the binding nature of the debt servicing constraint. In effect, a larger debt outstanding signifies larger debt servicing, *ceteris paribus*, and a higher level of international reserves indicates that the debt constraint is less binding in the sense that the country has greater ability to service its debt.

Based on panel data for 1980-84, 1985-89 and 1990-94 (World Bank 1988/89, 1999) on 35 SSA countries, and as in Fosu (2007), the estimated debt equation is:

$$D = 16.0036 + 0.015067\ \text{NETDEBTX} \quad n = 94,\ R^2 = 0.597 \qquad (8)$$
$$(8.32) \quad (4.31)$$

where D is the debt service rate (per cent), NEDEBTX is net debt, expressed as a per cent of exports (ibid.); n the sample size; R^2 the coefficient of determination; and the t ratios are in parentheses. The above estimated equation is based on the random-effects (RE) model, which is observed here to be statistically superior to the alternate fixed-effects (FE) model on the basis of the Hausman chi-square test statistic of 0.292, with a

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9 Note that Figures 1 and 2 both use non-weighted means, in order to avoid likely biases toward the larger economies, such as Nigeria.

10 For example, during the oil price collapse of the early 1990s, the government of Nigeria unilaterally suspended some of its scheduled payments, illustrated by its decision in 1993 to limit its actual debt service payments to no more than 30 per cent of net oil revenues, thus unilaterally reducing the actual debt service ratio to 22 per cent and 14 per cent in 1990 and 1996, respectively, for instance (Iyoha and Oriakhi 2004).

p-value of 0.588, thus maintaining the null hypothesis of RE. Despite its relative simplicity, equation (8) seems to provide a rather good fit, with the coefficient of the net debt variable displaying very high significance.

Predicted debt service, presented in equation (8), then, constitutes the binding nature of the debt service and thus the debt-servicing burden. For example, in many African countries actual debt payments fall short of that required, with accumulated arrears historically the norm, resulting in debt rescheduling, for instance, as a means of circumventing the binding nature of the debt constraint (Greene 1989). Conversely, a country may opt to pay more than is required due to its higher ability to pay, as indicated by a larger level of foreign reserves for instance. A higher debt service rate in this case would thus imply less, rather than greater, debt burden. Hence, equation (8) should more realistically reflect the debt-induced liquidity constraint by mitigating the 'noise' in actual debt service payment.

4.3 Summary statistics

Table 1 presents summary statistics on the variables used in the regression estimation. Concerning the main regressor of interest, as expected, the predicted debt service variable based on equation (8), PREDSR, exhibits less variability than does the actual debt service, DSR. On the one hand, if DSR were the correct debt-servicing variable, its larger standard deviation could actually translate to better precision for the estimated effect of debt servicing. On the other hand, if the higher standard deviation reflected 'noise' as conjectured above, then DSR would be insignificant in the health-expenditure equation. Reflecting the binding nature of the debt constraint, however, PREDSR should be superior to DSR as an explanatory variable.

Table 1
Summary statistics – Debt servicing and expenditure composition in Africa, 1975-94

Variable	Mean	Std dev.	Min	Max
GEC	26.64	11.96	6.60	63.40
GEH	5.38	1.98	0.50	11.10
GEE	14.84	4.55	1.80	24.50
GESS	20.28	5.88	2.30	34.50
GEEC	23.50	8.56	7.70	44.50
GEAG	7.96	3.69	1.0	24.30
PUINV	9.36	6.22	-0.60	45.70
DSR	20.21	12.36	1.45	56.69
PREDSR	20.21	4.46	14.93	49.53
ODAGDP	12.30	9.95	0.10	53.90
PCGNP	579.42	732.6	94.00	4428.0
AGCON	33.55	14.88	4.29	71.88
XCONST	2.44	1.66	1.0	7.0

Notes: Definitions of variables:

GEC: Share of government expenditure on capital, in per cent (source: World Bank 1992, 1996, 1998/99).

GEH: Share of government expenditure on health, in per cent (source: ibid.).

GEE: Share of government expenditure on education, in per cent (source: ibid.).

GESS: Share of government expenditure on social sectors: education and health, i.e., GEE+GEH, in per cent (source: ibid.).

Notes to Table 1 (con't)

GEEC: Share of government expenditure on economic services, in per cent (source: ibid.).

GEAG: Share of government expenditure on agriculture, in per cent (source: ibid.)

PUINV: Share of government expenditure on public investment, in per cent (source: ibid.).

DSR: Debt service ratio, defined as debt service payment as a per cent of exports (source: World Bank 1988/89, 1999).

PREDSR: Predicted debt service ratio (estimated by author using data from World Bank 1988/89, 1999; see text for details).

ODAGDP: ODA as per cent of GDP (source: World Bank 1999).

AGCON: Percentage of the population in agriculture (source: World Bank 1992, 1996, 1998/99).

PCGNP: Per capita GNP, expressed in 1987 US dollars (source: World Bank 1992, 1996, 1998/99).

XCONST: Degree of constraint on the executive, ranging from 1 to 7, with 7 as the greatest constraint (source: Polity IV Dataset).

Sample: The sample comprises 1975-1994 half-decadal panel data for 35 Sub-Saharan African countries. Due to missing data, the maximum sample size is 85 (maximum number of observations associated with at least one dependent variable); however, 41 usable observations were available for the estimation of the full seemingly unrelated regression (see Table 2).

5 Estimation

In order to estimate the set of equations (7^j), it should be noted that the functional sector expenditures are likely to be correlated across equations, given the nature of the budgeting process. That is, COV(u_j, u_k) is nonzero, for j not equal to k, so that the appropriate model is the seemingly unrelated regression (SUR) (Zellner 1962).

Presented in Table 2 are the SUR results based on the multiplicative (log-linear) specification of the set of equations (7_j).[11,12] Based on the basis of the Breusch-Pagan statistic, the cross-sector perturbations are indeed correlated, suggesting that SUR is the appropriate estimating procedure. Furthermore, note that the respective equations for expenditures in the social, agriculture, and public investment sectors provide good fits based on the chi-square test statistics presented in the table. In contrast, the model for economic-services spending does not, while the goodness of fit for the capital expenditure equation is rather weak.

Regarding the main focus of the present paper, the effect of debt servicing varies substantially across sectors. While the estimated coefficient of the debt variable, PREDSR, is negative and highly significant for the social sector, it is generally insignificant in the remaining equations, except possibly in the public investment (PUINV) model where it is negative with a reasonably high magnitude, though is statistically insignificant. In addition, the estimated impacts in the education and health

11 The time-period dummy variables are specified as (0, 1), however. The double-log specification follows others such as Dao (1995), Gbesemete and Gerdtham (1992), and Ouattara (2006). Results on the importance of 'binding' debt servicing based on the alternate linear specification are similar and are available upon request.

12 The set of equations that include the social-sector expenditure variable, GESS, and the non-social sectors is estimated, and then the set with the disaggregated social-sector variables, GEE and GEH, together with the non-social sectors is also estimated. Note that the estimates for the non-social sector expenditures are identical between the two sets of equations.

sectors do not seem to be statistically different from each other. These results suggest that a debt-servicing constraint would shift government spending away from the social sector, and possibly from public investment as well. However, the servicing constraint appears inconsequential for the remaining sectors individually.[13]

Table 2
Seemingly unrelated regression results: debt servicing and expenditure composition in Africa, 1975-94
(dependent variables = logarithmic expenditure shares)

VAR/EQ.	GEE	GEH	GESS	GEC	GEEC	GEAG	PUNIV
CONST	4.632 [b]	6.580 [b]	5.603 [a]	0.946	4.651	4.940	7.901 [b]
	(2.15)	(2.34)	(2.80)	(0.25)	(1.47)	(1.58)	(2.03)
PREDSR	-1.497 [a]	-1.824 [a]	-1.551 [a]	0.320	0.014	0.003	-1.244
	(-2.98)	(-2.79)	(-3.33)	(0.36)	(0.02)	(0.00)	(-1.38)
ODAGDP	0.212 [a]	0.199 [a]	0.212 [a]	0.041	-0.015	0.117	0.215 [b]
	(3.66)	(2.64)	(3.94)	(0.40)	(-0.18)	(1.39)	(2.06)
PCGNP	0.232 [c]	0.039	0.189	0.162	-0.215	-0.364 [c]	-0.145
	(1.80)	(0.23)	(1.58)	(0.72)	(-1.13)	(-1.95)	(-0.62)
AGCON	0.241	0.003	0.173	0.196	-0.082	-0.370	-0.348
	(1.50)	(-0.01)	(1.16)	(0.69)	(-0.35)	(-1.57)	(-1.20)
XCONST	0.026	0.142	0.052	-0.256 [b]	0.074	0.250 [b]	-0.092
	(0.38)	(1.58)	(0.81)	(-2.12)	(0.73)	(2.48)	(-0.75)
D7579	-0.396 [b]	-0.564 [a]	-0.441 [a]	0.050	0.119	0.124	-0.117
	(-2.43)	(-2.66)	(-2.92)	(0.17)	(0.50)	(0.53)	(-0.40)
D8084	-0.158	-0.323 [c]	-0.206	-0.357	-0.089	-0.076	-0.305
	(-1.14)	(-1.79)	(-1.60)	(-1.46)	(-0.44)	(-0.38)	(-1.22)
D8589	-0.122	-0.163	-0.139	-0.430 [c]	-0.064	0.186	-0.305
	(-0.84)	(-0.87)	(-1.03)	(-1.67)	(-0.30)	(0.89)	(-1.17)
RS*Q*	0.51	0.49	0.57	0.20	0.15	0.40	0.33
chiSQ	42.05 {.00}	38.82 {.00}	54.15 {.00}	10.52 {.23}	7.17 {.52}	26.82 {.00}	20.14 {.00}
*Breusch_Pagan 1**	64.76 {.00}						
*Breusch_Pagan 2***	78.45 {.00}						

Notes: * Based on SUR estimation involving GESS (instead of GEE and GEH) and the other variables;

** Based on SUR estimation involving GEE and GEH (instead of GESS) and the other variables;

[a] significance at the 0.01 two-tailed level;

[b] significance at the 0.05 two-tailed level;

[c] significance at the 0.10 two-tailed level;

D7579, D8084, and D8589 are time-period dummy variables, respectively, assuming unity for sub-periods 1975-79, 1980-84 and 1985-89, and zero otherwise; the excluded time variable is D9094 for the 1990-94 sub-period. All other variables are defined in Table 1. Each explanatory variable, except the time-period dummies, is in logarithms.

Z-values are in parentheses, and *p-values* in braces. *RSQ* is the coefficient of determination; *chiSQ* is the chi-squared test statistic for the null hypothesis of 'no model fit'; *Breusch_Pagan* is the test statistic for the null hypothesis of cross-equation error independence, which is distributed as chi-squared with degrees of freedom equal to the number of equations. Note that GESS is first run together with GEC, GEEC, GEAG and PUINV; GEE and GEH are then run together with these other non-social sector variables; however, the estimates are identical for the non-social sector variables in both estimations.

Sample size equals 41.

13 Note that not all functional sectors are represented here. The expenditure shares add up to 88 per cent, suggesting that there is a residual 'other' category that is excluded from the SUR estimation, as it should be in order to render the system estimable.

Considered next are the effects of the remaining regressors. The external aid variable, ODAGDP, exhibits significantly positive coefficients, with similar magnitudes, for the social sector and public investment. The estimated aid effects on education and health are both significantly positive, and appear to be statistically indistinguishable from each other. Hence, aid tends to shift public expenditure in favour of the social sector and public investment. The results are similar to those of Ouattara (2006), for instance, who finds positive aid effects for public investment and development expenditures (health and education expenditures combined). The results here also provide support for Gbesemete and Gerdtham (1992), who report a positive aid effect on health spending based on 1984 cross-country analysis of African countries. Nonetheless, it is important to underscore the point that the aid impact is miniscule, especially when compared with the debt effect.

On the importance of the level of development, it is observable from Table 2 that the impact of per capita income, PGNP, is small; it is only weakly significant in the education and agricultural sectors, where it is positive and negative, respectively. The former suggests the 'luxury' nature of education, in that a higher PGNP would shift expenditure in favour of education, though this effect is marginal. In contrast, a higher PGNP appears to reduce the expenditure share in agriculture, which is likely to be 'non-luxury'. The other level-of-development variable, the relative population size of agriculture, AGCON, appears to have little cross-sectoral effects.[14]

The political constraint variable, XCONST, displays a negative and significant coefficient in the capital expenditure equation but a statistically positive one in the case of agriculture. These results suggest that an increasing level of constraint on the government executive would shift public expenditure away from capital but into agriculture. This is an interesting finding that seems to support the view that corruption is more likely in those sectors where there is much to be garnered as rent in terms of capital projects (Tanzi and Davoodi 1997). Indeed, it may be noteworthy that the coefficients of XCONST are nearly identical in magnitude between agriculture and capital expenditures while remaining insignificant in the remaining sectors, suggesting a one-to-one expenditure substitution between these two sectors.

Results involving the time-dummy variables point to some cross-sectoral differences as well. The only sector where these variables appear to matter, and most strongly when the 1975-79 period is compared with the early 1990s, is the social sector, where there seems to be an upward trend of expenditure shares. This finding is in concert with the preliminary 'gross' results reported above in Figure 1.

Estimating the system of equations involving all the sectors above entailed the use of only the observations that had usable data for each sector. Unfortunately, this restriction reduced the sample size to only 41. Having observed above that the deleterious impact of the debt-servicing constraint was a phenomenon of the social sector, we now explore the robustness of this finding using a larger sample involving just the social sector. We do this by applying SUR to re-estimating the system of two equations involving just the

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14 As in other studies (e.g., Cashel-Cordo and Craig 1990; Fosu 2007; Gbesemete and Gerdtham 1992), we also included in the regression the structure of the population, measured as the share of the population under 14 years of age; however, this variable proved extraneous, as it did in the above studies as well.

social sector (education and health), which entailed a much larger sample size of 79 compared with the 41 earlier used to estimate six equations.[15] Results of the estimation are presented in Table 3, first for the debt-servicing constraint variable, PREDSR (3.I), and second for actual debt, DSR (3.II). The purpose of the additional set of results involving DSR is to shed light on the relative performance of these two debt-servicing variables, in order to verify the basic premise that PREDSR is a better measure of the debt constraint.

As the results of Table 3.I indicate, the external debt-servicing constraint would shift public expenditure away from both health and education, consistent with the above result based on the smaller sub-sample. Indeed, the estimated coefficients and significance are comparable to the smaller-sample estimates, though the estimated impact on the health expenditure share appears smaller in the larger sample, while that for education has risen slightly. The important point to stress here, though, is that the estimates based on the larger sample are comparable to those from the smaller sample. These results, then, provide some confidence in the possible robustness of the results involving the impact of debt servicing on social-sector spending.

Table 3
Seemingly unrelated regression results: debt servicing and expenditure composition in Africa, 1975-94 – the social sector (dependent variables = logarithmic expenditure shares)

I: Predicted debt service			II: Actual debt service		
VAR/EQ.	GEE	GEH	VAR/EQ.	GEE	GEH
CONST	6.144 [a] (3.88)	5.006[b] (2.51)	CONST	0.900 (0.90)	0.501 (0.25)
PREDSR	-1.615 [a] (-4.16)	-1.370 [a] (-2.80)	DSR	-0.062 (-1.25)	-0.032 (-0.52)
ODAGDP	0.072 [c] (1.94)	0.134 [a] (2.90)	ODAGDP	0.081 [c] (2.02)	0.144 [a] (2.96)
PCGNP	0.127 (1.32)	0.047 (0.39)	PCGNP	0.255 [b] (2.57)	0.160 (1.33)
AGCON	0.194 [c] (1.84)	0.070 (0.53)	AGCON	0.141 (1.23)	0.02 (0.14)
XCONST	0.009 (0.17)	0.148 [b] (2.15)	XCONST	-0.018 (-0.30)	0.124 [c] (1.74)
D7579	-0.397 [a] (-3.30)	-0.337 [b] (-2.23)	D7579	-0.249 [c] (-1.90)	-0.187 (-1.18)
D8084	-0.291 [a] (-2.73)	-0.310 [b] (-2.31)	D8084	-0.232 [b] (-2.01)	-0.256 [c] (-1.84)
D8589	-0.208 [c] (-1.85)	-0.134 (-0.95)	D8589	-0.216 [c] (-1.76)	-0.143 (-0.96)
RSQ	0.33	0.31	*RSQ*	0.20	0.25
chiSQ	39.21{.00}	35.92{.00}	*chiSQ*	19.85{.01}	25.91{.00}
Breusch_Pagan	20.93{.00}		*Breusch_Pagan*	25.70{.00}	

Notes: [a] significance at the 0.01 two-tailed level;
[b] significance at the 0.05 two-tailed level;
[c] significance at the 0.10 two-tailed level;
Sample size equals 79. See Table 2 for other notes.

15 The larger sample was made possible by the use of expenditure data for only health and education; the smaller sample resulted from the incidence of a greater number of missing values due to the requirement that all values for a given observation be available for all six equations.

For several of the other variables, however, there appear to be considerable differences between the results for the larger sample and those of the sub-sample, though the qualitative findings reported above remain immutable. This is the case particularly for the external aid variable, ODAGDP, whose estimated effects are now lower in both magnitude and significance, though the estimated coefficients remain statistically positive. However, the impacts of the executive constraint variable, XCONST, remain positive for both education and health, but with improved precision for the latter. Finally, the earlier observation that expenditure shares have trended upward in the social sector is actually supportable even more strongly in the larger sample. Despite these differences, it must be emphasized that the results here are generally similar to those in the smaller subsample reported in Table 2.

To highlight the importance of the predicted, rather than actual, debt servicing as reflecting the binding debt-service constraint, we now turn to Table 3-B, where actual debt servicing is employed in the estimation. We observe, first, that the respective equations are relatively poorly estimated, as evidenced by the coefficient of determination, for instance. Second, the positive impact of PCGNP is overestimated. Finally, and most important for the main objective of the present study, the coefficients of actual debt servicing, measured by DSR, are of very low magnitudes and are statistically insignificant. This finding is similar to that of Ouattara (2006), for example, who estimates insignificant impacts of (actual) debt servicing on 'development expenditures', a variable that comprises education and health spending. Using observed debt-servicing data then appears to underestimate the impact of the debt service burden,[16] thus underscoring the need to employ PREDSR, for instance.

Selecting the coefficients in Table 3.I as the 'best' estimates of the impacts of the respective variables on social-sector expenditures, several observations are in order. First, the estimated debt-servicing impacts on both education and health are negative, suggesting that the debt service burden would siphon expenditure from the social sector. Second, and of special note, the respective elasticities of 1.6 and 1.4 for education and health represent, by far, the largest impacts among all the variables in the expenditure shares equations. Third, these estimated elasticities for education and health are statistically indistinguishable from each other. Finally, at an elasticity of 1.5,[17] the fiscal response of the social sector to the debt-servicing constraint is quite high. For example, if the binding debt service, measured by PREDSR, were to rise by one standard deviation (4.5 percentage points) from its mean of 20.2 per cent of exports to roughly 24.7 per cent, we should expect the spending share for the social sector to be reduced by some 31.5 per cent ([ln24.7-ln20.2]1.5=0.315). This estimate does not seem paltry by any means, especially in many African countries where spending on the sector is already modest.

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16 Similar results are obtained when the entire set of equations is estimated involving all the six sectors (as in Table 2); however, they are not reported here for reasons of parsimony and are available upon request.

17 It is important to underscore the finding that the debt-servicing effect on the social sector does not change appreciably between the SUR results based on the smaller sample and those on the basis of the

6 Summary and conclusion

The current paper has explored the impact of a binding debt-servicing constraint on the fiscal response in several functional sectors in the developing economies of Africa, where the debt burden has been particularly prevalent historically. Based on 1975-94 five-year panel data, a set of sector equations is estimated using seemingly unrelated regression estimation that takes account of cross-sector correlation of the perturbation term.

The paper finds that a debt-servicing constraint would shift public expenditure away from the social sectors of health and education, and possibly from public investment. The deleterious debt impact on the social sector is particularly strong and represents the largest fiscal response among all the variables in the set of equations that also include other explanatory variables measuring external aid, per capita GNP, agrarian concentration, constraint on the executive of the government, and inter-temporal factors. The partial elasticity of the expenditure share with respect to binding debt servicing for the social sector (education and health) is estimated at 1.5, with statistically indistinguishable estimates for education and health. This value translates to a reduction by nearly one-third of the share allocation to the sector in response to a one-standard deviation increase in the debt burden.

As in other studies, external aid is observed here to exhibit positive impacts on the expenditure shares of the social and public investment sectors, though the impacts are rather small. This positive effect of aid may reflect the favourable preferences of donors toward these sectors. However, the relatively small responsiveness of sectoral expenditure to ODA may be indicative of considerable fungibility of aid. Another variable that has intersectoral expenditure implications is the constraint on the government executive of the government. The paper finds that a higher level of executive constraint, presumably reflecting less corruption, shifts the budget allocation from capital expenditures toward agriculture and, possibly, to health as well.

The study has also uncovered intertemporal effects of sectoral expenditure allocation, but not in line with the popular view that spending on this sector has waned over time, particularly as a result of IMF/World Bank-administered structural adjustment programmes of the 1980s. What our results show instead is that not only have the expenditure shares of both education and health increased over time, but also that real per capita expenditures on these sectors have trended upward.

With respect to the main objective of the present paper, the findings suggest that debt relief would have intersectoral consequences. In particular, the fiscal response of the social sector to debt relief would be positive and substantial. Furthermore, from a policy perspective, the response would be considerably higher than that attributable to external aid. That the sample period employed in this study precedes the HIPC debt-relief initiatives beginning in the latter 1990s, moreover, suggests that the current results are unlikely to be influenced by the prescriptions of those initiatives. Instead, the countries' own budget allocation preferences appear to be ex-ante consistent with the tendency of donors to favour the channelling of debt relief into social spending, a finding that should facilitate the attainment of the HIPC objectives.

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larger sample. Hence, using the debt-service coefficient for GESS from Table 2, as we do here, is defensible.

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