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Financing the HIV response in sub-Saharan Africa from domestic sources: Moving beyond a normative approach

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ABSTRACT

Despite optimism about the end of AIDS, the HIV response requires sustained financing into the future. Given flat-lining international aid, countries' willingness and ability to shoulder this responsibility will be central to access to HIV care. This paper examines the potential to expand public HIV financing, and the extent to which governments have been utilising these options.

We develop and compare a normative and empirical approach. First, with data from the 14 most HIV-affected countries in sub-Saharan Africa, we estimate the potential increase in public HIV financing from economic growth, increased general revenue generation, greater health and HIV prioritisation, as well as from more unconventional and innovative sources, including borrowing, health-earmarked resources, efficiency gains, and complementary non-HIV investments. We then adopt a novel empirical approach to explore which options are most likely to translate into tangible public financing, based on cross-sectional econometric analyses of 92 low and middle-income country governments' most recent HIV expenditure between 2008 and 2012.

If all fiscal sources were simultaneously leveraged in the next five years, public HIV spending in these 14 countries could increase from US$3.04 to US$10.84 billion per year. This could cover resource requirements in South Africa, Botswana, Namibia, Kenya, Nigeria, Ethiopia, and Swaziland, but not even half the requirements in the remaining countries. Our empirical results suggest that, in reality, even less fiscal space could be created (a reduction by over half) and only from more conventional sources. International financing may also crowd in public financing.

Most HIV-affected lower-income countries in sub-Saharan Africa will not be able to generate sufficient public resources for HIV in the medium-term, even if they take very bold measures. Considerable international financing will be required for years to come. HIV funders will need to engage with broader health and development financing to improve government revenue-raising and efficiencies.

1. Introduction

Despite optimism about the end of AIDS, and remarkable progress towards this ambition, a sustained HIV response will be required for years to come. HIV remains the fifth global cause of morbidity and mortality, and ranks second in sub-Saharan Africa (Murray et al., 2012). Unprecedented resources have been mobilised in response to the epidemic, reaching US$19.1 billion in 2013 in low and middle-income countries. Yet, this still falls short of UNAIDS' previous resource needs estimates of US$22–24 billion by 2015 and its US$36 billion estimate for 2020 in the ambitious 'fast-track' scenario that would seek to reduce the number of new infections and AIDS-related deaths by 90% by 2030 (UNAIDS, 2014a).

With the success of antiretroviral therapy (ART), HIV infection is no longer a death sentence, and national governments face the challenge of how to sustain their growing obligations and duty to maintain people on life-long treatment (Lule and Haacker, 2012), alongside laudable commitments to continue scaling up treatment

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access for all those who are HIV-infected (UNAIDS, 2014a), and the need to continue investing in HIV prevention to reduce the rate of new infections. This challenge is substantial. A recent paper estimates the fiscal consequences of this moral duty to treat (Collier et al., 2015). The figures are stark. In a scenario where 81% of people living with HIV with CD4 counts below 350 mm^3 are on ART, the fiscal obligations of treatment alone until 2050 have been conservatively estimated at 21% of current Gross Domestic Product (GDP) for South Africa, and 80% of current GDP for Malawi, among others (Collier et al., 2015). The International Monetary Fund (IMF) sets the 'sound' threshold for the debt burden of countries at 40% of GDP, and therefore this hidden HIV-obligation is potentially of real economic concern for both governments and donors. Some now argue that HIV is a fiscal as well as a public health crisis, particularly in sub-Saharan Africa (Collier et al., 2015; Vassall et al., 2013).

To date, much of the HIV response across the region has depended on international financing: only 10%–22% of HIV expenditures in 2013 were financed from domestic sources in low-income and lower-middle-income countries respectively (UNAIDS, 2014a). However, with the flat-lining of external HIV funding commitments, optimistic economic growth forecasts and the prospects of increased revenues from natural resources (Vassall et al., 2013), several global and regional declarations have called for African governments to fund more of their own responses (Buse and Martin, 2012; Galarraga et al., 2013; Resch et al., 2015). This, it is argued, would allow donors to refocus their resources on countries that most need external support (Resch et al., 2015). In addition, there is a growing promotion of 'innovative financing' mechanisms – such as earmarked taxes or diaspora bonds (Atun et al., 2012; Katz et al., 2014b) – to create new sources of HIV financing. A withdrawal or re-allocation of donor financing, without a compensating domestic financing response, may affect the continuity of care for those on treatment, and/or have high opportunity costs by removing financing from other critical areas of domestic spending both within or beyond the health sector. Paradoxically, some of these other areas of spending may also be fundamental to the effectiveness of the HIV response, such as education or the strengthening of health systems (McIntyre and Meheus, 2014; Seeley et al., 2012). It is therefore important to understand the factors that influence countries' potential ability to sustainably fund their national HIV response, without negatively impacting on spending in other critical areas or undermining macroeconomic conditions.

Previous investigations into the amount of domestic financing available for the HIV response have not been comprehensive or formally adjusted for past patterns of financing. These analyses may have been overly simplistic; providing a partial understanding of the overall potential financing available. Some have analysed the determinants of domestic financing for HIV or the potential of specific financing sources (Avila et al., 2013; David, 2009; Galarraga et al., 2013; Katz et al., 2014b; Resch et al., 2015; van der Gaag et al., 2009; Zeng et al., 2012). However, none of these studies considered options under all of the potential sources for generating new resources (revenue mobilisation); sharing existing resources differently (reallocation); and spending existing resources better (efficiency gains). Previous analyses have only considered spending for services within the health or HIV boundaries, and do not consider how spending in other sectors that also influence health or HIV may contribute to effective financing of the HIV response. Finally, most estimates of domestic financing for HIV to date have used normative targets in areas such as allocations to the health sector and general revenue generation capacity, assuming that these norms can be reached (Resch et al., 2015), although there is one previous study that examines whether countries can achieve levels of spending observed among their peers (Galarraga et al., 2013), but does not examine whether these levels are optimal.

Focusing on the 14 most HIV-affected countries in SSA, this paper explores the potential to expand domestic financing for HIV from a comprehensive range of domestic sources, including general health and cross-sectoral financing streams. We examine the financing system as a whole, incorporating changes in efficiency of spending, as well as revenue-raising. We use two approaches: one focused on achieving a range of financing targets - our 'normative' approach; and the other that incorporates previous fiscal behaviours, to try to incorporate the 'real world' constraints on domestic financing. For the latter, we examine historical fiscal data to explore how much changes in key characteristics of domestic public finance (such as proportional spend on health care) have led to changes in HIV expenditure. In doing so, we aim to demonstrate a comprehensive empirical approach to estimating the available domestic financing for HIV, and provoke discussion on the appropriate policy response and allocation of international financing for the HIV response in the coming years.

2. Methods

We applied the concept of 'fiscal space' to explore how much additional public financing could be made available for HIV in the next 5 years, in the 14 sub-Saharan African countries with the largest HIV epidemics and expected fiscal burdens (Lule and Haacker, 2012; UNAIDS, 2014b)– South Africa, Nigeria, Kenya, Mozambique, Uganda, Tanzania, Zimbabwe, Malawi, Zambia, Ethiopia, Lesotho, Botswana, Namibia and Swaziland. These include the 10 countries with the most people living with HIV (PLHIV) and all hyperendemic countries, with adult prevalence above 15%. Together they account for 85% of the disease burden in the region, in terms of number of PLHIV (UNAIDS, 2014b). Our analysis focused on the medium-term, i.e. the next 5 years, given the uncertainty around the macroeconomic and political context in the longer run, but we discuss the implications for addressing the substantial economic challenge of HIV financing in the coming decades.

In public finance, 'fiscal space' is used to describe the budgetary space available to allocate public resources to a specific objective, without damaging other developmental or macroeconomic objectives (Roy and Heuty, 2009; World Bank and IMF, 2006), including fiscal sustainability. The potential sources of fiscal space for HIV are similar to those for health services generally, but may vary across countries. Theoretically, domestic sources include: (1) conducive macroeconomic conditions through economic growth, (2) improved taxation/revenue generation, (3) borrowing, (4) reprioritisation (within the government or health budget), (5) sector-specific earmarked sources of revenue, and (6) efficiency gains (Heller, 2006; Powell-Jackson et al., 2012; Tandon and Cashin, 2010). An additional external source is external grants.

To explore which financing policy options have the most potential to create fiscal space for HIV – measured as increased public HIV spending – we followed two approaches. The first 'extended normative' approach considers what countries *could be spending*, given their fiscal position, health system and epidemic context. We estimated how much fiscal space could be created for HIV in a specific country by reaching a normative target or benchmark, using a comprehensive set of fiscal space sources, and holding all other factors constant. For example, how much more could a country spend on HIV if the health share in government spending was increased to the so-called Abuja target of 15% that was agreed upon in 2001, and HIV spending increased proportionately? These estimates are likely to be optimistic and can be seen as representing an upper bound estimate of fiscal space.

In the second approach, we seek to challenge these optimistic estimates to reflect some of the uncertainty around the impact of

each fiscal policy change on the fiscal space for HIV, by incorporating empirical evidence on how the different fiscal levers were associated with public HIV expenditure in the past. This empirical approach aims to explore which financing options are most likely to translate into real increases in public HIV resources based on past behaviours. To do this, we developed econometric models to test to what extent variation in public HIV spending between countries may be explained by variation in the different fiscal levers. This second approach incorporates the possibility that changes in fiscal indicators may not always 'trickle-down' to changes in public HIV spending. For example, an increase in the share of health in the national budget may result in a decrease in the relative share of HIV in the heath budget, if policy makers are satisfied with levels of HIV spending.

2.1. Data sources

We used publicly available data on the latest fiscal, macroeconomic, epidemiological, expenditure and health system data available between 2008 and 2012. A full description of all data sources is contained in the Supplementary appendix. We analysed the fiscal space implications for the 14 selected sub-Saharan African countries, but for the empirical approach, we used a cross-sectional dataset of 92 countries. Table 1 presents its summary statistics. We did not impute missing values, potentially underestimating fiscal space in certain countries, when country-specific data was not available. All monetary figures are expressed in 2014 US$.

2.2. Extended normative approach

Our extended normative analysis considered how much additional resources could be generated if countries were to meet targets or benchmarks anchored in either fiscal capacity, minimum standards or optimal targets. We drew on the framework of domestic fiscal space sources above. In addition to forecasted economic growth, government revenue generation, and the prioritisation benchmarks used in a recent study (Resch et al., 2015), we included borrowing and incorporated new norms for the earmarked revenue category and efficiency gains. We used norms set by global/regional agreements, governing bodies or institutions, such as the International Monetary Fund (IMF). Where these were not available, we developed norms based on optimal levels from other countries as described below. All financing sources and measures are summarised in Table 2.

Compared to previous normative analyses (David, 2009; Resch et al., 2015; van der Gaag et al., 2009), we included three additional components of fiscal space. First, we attempted to quantify the potential fiscal space from health-earmarked revenue sources, using the example of social health insurance. To estimate how much fiscal space may be generated from such a scheme, we assumed current out-of-pocket expenditures in excess of the WHO acceptable level of 20% of total health expenditure spent in the private sector, could be converted into social health insurance premia that would flow to the government health budget and be used for strategic purchasing (Kutzin, 2013). We also examined the fiscal space generated by an increased excise tax on alcohol (beer specifically), whereby the net additional revenue from increasing the tax from its current level to the West African Economic and Monetary Union's threshold of 50% (Mansour and Graziosi, 2013) could be allocated to health, and proportionately to HIV.

Second, we constructed a simple measure of technical efficiency using the ratio of non-drug expenditures per person retained on ART to GDP per capita, and identified the best performing country among the 14 countries per income category (low-income, lower-middle-income, upper-middle-income). We then estimated logarithmic functions for each income category based on these best performers and the finding from a cross-country empirical analysis of ART unit costs that found that a doubling in per-capita GDP was associated with a 22% increase in non-drug ART unit costs (Menzies et al., 2012). These function served as an efficiency frontier to estimate each country's potential non-drug ART unit cost given its GDP per capita, and how much fiscal space would be generated if each country reached that benchmark in their HIV programme, thereby freeing up further resources to spend on HIV services. It is worth pointing out that we did not find an adequate cross-country measure of allocative efficiency between HIV programme areas, while this may be a key source of efficiency gains.

Finally, while previous analyses have implicitly assumed that less prioritisation of the HIV programme would reduce fiscal space for HIV improvement (David, 2009; Resch et al., 2015), we explored the potential HIV gains from reprioritisation towards investments in other areas of spending (either in health systems, or in other sectors) that have been shown to improve HIV outcomes. To illustrate this potential, we used an exploratory cross-sectional econometric model for Prevention of Mother-to-Child HIV Transmission (PMTCT) screening (see appendix S12), which examines how much higher PMTCT screening coverage could be achieved if countries achieved the WHO minimum norm of having 2.3 health workers per 1000 population. We then estimated how much more a country would have had to spend in total on HIV to achieve that same increase. We applied that percentage increase to the public HIV spending figure, as a measure of potential savings to the HIV budget from investments by other budgets. Put differently, by using the effects of human resource inputs and financial inputs on service coverage, we were able to calculate the monetary valuation of the effect of increasing the number of health workers to the norm, from the HIV budget holder's perspective. To illustrate the same potential for interventions outside the health sector (Seeley et al., 2012), we took the example of how a reduction in undernourishment to the Millennium Development Goal (MDG) target, could improve

Table 1
Summary statistics of the variables in the regression analyses.

Variable	n	Mean	Standard deviation	Min	Max
Public HIV spending per PLHIV (US$)	92	347	565	2	3191
GDP per capita (US$)	92	3225	3173	239	11,695
Adult HIV prevalence (%)	92	3%	5%	0%	27%
Control of corruption index[a]	92	4.36	0.51	3.54	5.94
International HIV spending per PLHIV (US$)	92	419	457	1	2137
Government revenue, excluding grants (% of GDP)	92	23%	9%	10%	57%
Gross Government Debt (% of GDP)	87	41%	23%	9%	143%
Government Health Expenditure (% of Government Expenditure)	91	11%	5%	2%	28%
Out-of-pocket health expenditure per capita (US$)	90	68	76	2	382
Non-drug cost per person retained on antiretroviral treatment (US$)	86	1152	1349	37	6793
Public HIV Spending (% of Government Health Expenditure)	92	3%	8%	0%	69%

[a] This Worldwide Governance Indicator is rescaled to range from 2.5 to 7.5.

Table 2
Fiscal space framework and measures used per source.

Source	Indicator	Modelled target	HIV adjustment
Economic growth	GDP, constant $ *(IMF)*	Average forecasted annual growth (2014–2018)	
Improved government revenue generation	Government revenue, excluding grants, as % of GDP *(World Bank)*	25% (*McIntyre and Meheus, 2014*)	
Reprioritisation – of Health	General government health expenditure as % of Total government expenditure *(WHO)*	15% *(Abuja target)*	
– of HIV	Public HIV spending as % of Government health expenditure *(UNAIDS, WHO)*	0.5 × HIV DALYs as % of total DALYs (*IHME, 2010 Global Burden of Disease data*)	
Government borrowing	Gross debt as % of GDP *(IMF)*	40% *(IMF 'sound' level)*	
Health-earmarked resources – Risk pooling mechanisms	Reduced out-of-pocket health expenditure per capita through contributory pooling mechanism *(WHO)*	20% *(WHO acceptable level)*	50% of spending in excess of threshold converted from private sector to government health resources; minus risk-pooling mechanism administration cost (of US$ 1.77 per capita) then apportioned to HIV based on current ratio of total HIV spending to total health spending
– Innovative domestic financing	Increased revenues from increase in excise tax on alcohol (beer) *(WHO)*	50% *(West African Economic and Monetary Union threshold)*	Minus reduction in sales due to tax assuming −0.3 price elasticity deducted from total revenue; then apportioned as above
Efficiency gains – Treatment & care programme technical efficiency	Ratio of Non-drug treatment spending per person retained on ART to GDP per capita *(UNAIDS)*	Non-drug unit cost estimated from logarithmic production possibility frontier derived from most 'efficient' country with the minimum ratio by income group:16% (Zimbabwe) for LICs; 9% (Zambia) in LMICs; 15% (Botswana) in UMICs	Number of people receiving antiretroviral drugs (ARVs) adjusted by 12 month retention rate; Share of savings in total HIV treatment and care spending then applied to public HIV spending
– Health system technical efficiency gains for the PMTCT programme	Aggregate health personnel density *(WHO)*	2.3 per 1000 population *(WHO minimum level)*	Regression model of PMTCT screening coverage, with Nurse density, Proportion of undernourished in total population, HIV prevalence, GDP per capita, Total HIV spending per PLHIV, Adult female literacy, Urbanisation rate *(see Appendix for details)*
– Non-health sector efficiency gains for the PMTCT programme	Proportion of undernourished People in the total population *(FAO)*	11.7% *(MDG1 target of halving 1990 level of 23.4% in developing countries)*	

HIV service coverage – again using PMTCT screening coverage – and therefore free up space in the HIV budget (Remme et al., 2014).

2.3. Empirical approach

To examine how domestic HIV spending in low and middle-income countries was associated with movements in different fiscal levers in the past, we constructed separate econometric regression models for each fiscal space source used in the extended normative approach, except the non-HIV efficiency sources that were estimated for illustrative purposes from a separate model described in the appendix.

Each of the regression models are specified as follows:

$$Y_j = \theta_i C_{ij} + \beta x + \varepsilon_j \quad (1)$$

where Y_j, the dependent variable, is public HIV spending per person living with HIV (PLHIV) in country *j*; C_{ij} is a vector of covariates c_i with θ_i vector of mean coefficients; x is each explanatory variable (or fiscal space source) with β its mean coefficient; and ε_i is an error term. The dependent variable and independent variables with monetary values or proportions were transformed into natural logarithmic form, implying that the coefficients of the independent variables can be interpreted as elasticities, or measures of responsiveness (Gerdtham et al., 1992).

Covariates were selected based on a previous study investigating the determinants of domestic HIV spending (Avila et al., 2013). These include disease burden (HIV prevalence), quality of governance (control of corruption), and national income level (GDP per capita). In addition, we include international HIV spending per PLHIV as a covariate, given the potential interaction and fungibility with public spending, as documented in the health expenditure literature (Lu et al., 2010). The year of the spending data was added as a time trend variable for the independent effect of changes in technology, medical practices and cost pressures (Fan and Savedoff, 2014). Finally, we included regional dummies to account for qualitative differences between UNAIDS regions.

We specified seven different models. In the first model, we included all the aforementioned covariates and the first theoretical source of fiscal space: economic growth, proxied by GDP per capita as the independent explanatory variable. In the seven successive models, we kept GDP per capita as a covariate and added variables for each theoretical source of fiscal space one by one (models 2 to 8). We would expect public HIV spending per PLHIV to be positively associated with GDP per capita, government revenue, government health and HIV prioritisation (David, 2009; Heller, 2006; Resch et al., 2015); but negatively associated with out-of-pocket health expenditures per capita (the inverse of the extent of risk pooling) (Fan and Savedoff, 2014). The relationship with government debt could be either positive or negative, depending on whether additional borrowing frees up other government resources for the HIV programme (David, 2009; Elovainio and Evans, 2013). The relationship with the measure for technical efficiency (the non-drug cost per person retained on ART) is particularly ambiguous, as it

will depend on whether a more efficient ART programme attracts more government resources or less.

We used ordinary least squares estimation and performed standard diagnostic tests to validate the underlying assumptions. To explore the sensitivity of the findings and obtain additional insights into the variability of the effects, we used two additional estimation methods: quantile regression and neighbour matching fixed effects (Colombo et al., 2014). The former is less sensitive to outliers and accommodates for the effects of the independent variables to vary over quantiles of the dependent variable. Indeed, it is likely that public HIV spending is more or less responsive to changes in fiscal policy at different levels of spending. In addition, it is possible that our models omit important variables (observable or unobservable) that are driving both fiscal policies and public HIV spending. For example, certain dimensions of governance may not be sufficiently captured in our measures. To take this possibility into account, we applied neighbour fixed effects modelling (Colombo et al., 2014), which involves a matching exercise between neighbouring countries aimed at controlling for unobserved characteristics that are similar between neighbouring countries (see appendix 4.2.3).

2.4. Comparing the two approaches

We compared the cumulative maximum public HIV spending per PLHIV under the first approach where all normative targets are met, to an empirical scenario based on past government responsiveness to changes in each fiscal lever using the coefficients (or elasticities) from the OLS models for each statistically significant source of financing. Finally, we estimated the financing gap by comparing both estimates to the average annual fiscal cost of delivering HIV services over the same period in a continued scale-up scenario, as modelled in a recent analysis (Hontelez et al., 2016).

3. Results

As presented in Table 3, annual public HIV spending in the 14 countries is currently estimated at US$3.04 billion. Using the extended normative approach, we estimated that in the next five years an additional US$120 million could be generated per year from economic growth, US$79 million from improved revenue generation, US$888 million from borrowing, US$1.05 billion from increased health prioritisation, US$1.68 billion from greater HIV prioritisation, US$275 million from pooling out-of-pocket expenditures, US$171 million from increased alcohol taxation, and US$937 million from efficiency gains in the public HIV programme based on ART service efficiencies. Cumulatively, if all these fiscal levers were simultaneously leveraged, public HIV spending could reach US$10.84 billion per year. In addition, investments in the health system to increase human resources to the recommended minimum would reduce the need for additional direct HIV expenditures of US$418 million; while investments to reduce malnutrition could further save US$653 million of direct HIV investment (see appendix S13-15).

The largest sources of fiscal space varied considerably between countries and income categories. For our selected low-income countries, a greater prioritisation of HIV in the health budget could mobilise substantial resources. For the lower-middle-income countries, a greater prioritisation of health in the national budget had the greatest potential in the medium-term. The next best option was borrowing, which was largely driven by Nigeria's low debt ratio. For the upper-middle-income countries, greater HIV prioritisation in the health budget and savings following a more efficient delivery of ART services were the top source of fiscal space. Within the five-year period, economic growth and better revenue generation would provide comparatively fewer resources across all countries. Interestingly, the potential HIV budget savings from non-HIV investments compared favourably with other sources, especially in low-income countries.

There was substantial variation in both fiscal space and the number of fiscal levers available across countries. For example, Lesotho and Malawi have few options to create substantial fiscal space, whereas Nigeria could capitalise on several options that could independently double its current expenditure.

The empirical models in Table 4 show how much fiscal space was generated for HIV in the past from changes in each fiscal lever. They indicate that the assumption that other fiscal levers remain unaffected when one fiscal lever is changed may overestimate the potential for additional financing. Our analysis of the determinants of past spending suggested that only higher GDP per capita (economic growth) may have led to a more than proportionate increase in public HIV spending, as a 1% increase in GDP per capita was associated with 1.09% increase in public HIV spending (model 1). This may indicate that HIV services were viewed in economic terms as 'luxury' services, which received larger shares of income as income grew - or were 'income elastic'. However, since this coefficient is not significantly greater than 1 (ranging from 0.94 to 1.24), public HIV spending could also have received a smaller or equal share of national income as it increased). The neighbour pair fixed effects model presented in Table 5, found a higher and more robust income elasticity (1.25), while the quantile regressions suggested more responsiveness among the lower spenders (typically the lower-income countries) and less among the bigger spenders (1.21 vs 0.75).

Conversely, countries with a 1% higher prioritisation of health in the national budget only spent 0.40% more on HIV, indicating that countries spent disproportionately less of their larger health budget on HIV services. The bigger spenders (75th percentile) were more responsive to this lever, while the lower spenders might not have been (Table 5). Looking more closely at the determinants of HIV prioritisation, we found that countries with a 1% higher health share in the government budget, allocated 0.74% less to HIV from the health budget (appendix S11). This suggested that countries that prioritised HIV more, did so despite or in compensation of lower government health spending. Model 7 in Table 4 seems to further corroborate this, as even a 1% increase in the share of HIV in the health budget was only associated with a 0.76% increase in HIV spending. This low level of responsiveness, or 'inelasticity', is robust to all estimation methods (Table 5).

Other fiscal levers did not seem to have had an impact on HIV expenditures to date according to the OLS estimation, but their signs were consistent with our expectations and all coefficients suggested an inelastic relationship (<1). The models had relatively high explanatory power, and the diagnostic tests did not indicate concerns around model specification or omitted variables.

That being said, we gained further insights from the alternative estimation methods we used to explore what these results were sensitive to. For example, another noteworthy difference is that after adjusting for unobserved characteristics that are similar among neighbouring countries, improved government revenue generation appeared to be significantly associated with public HIV spending, while health prioritisation was not. This suggests that governments that were better at collecting revenue were also more consistently able and willing to spend those resources on HIV.

Another finding worth highlighting is the repeatedly significant positive relationship between countries' levels of public and international HIV spending. A 10% increase in international spending was associated with a significant 1.0%–4.0% increase in public HIV spending (Table 4). This may be linked to its significant positive relationship with government's prioritisation of HIV in the health budget (appendix S11).

Table 3
Potential medium-term sources of domestic financing (US$) in selected countries in sub-Saharan Africa based on the expanded normative approach.

	Current public HIV spending (US$)	Average additional public HIV spending (2014–2018 annualised, US$)								Maximum potential public HIV spending (US$)	Average HIV savings from non-HIV spending (2014–18, annualized, US$)	
		Economic growth	Govt revenue generation	External borrowing	Reprioritisation		Health-earmarked sources		Technical efficiency gains			
					Health	HIV	Health risk-pooling mechanism	Alcohol tax	Reduced ART non-drug unit cost		Expansion of HRH	Reduced undernourishment
Low-income countries												
Ethiopia	29,873,725	2,483,346	23,472,213	23,914,041	10,502,582	0	1,676,226	0	18,799,533	**218,672,382**	109,013,328	31,722,582
Malawi	2,076,376	148,797	0	0	0	28,452,963	0	11,280,604	0	**48,099,500**	5,917,374	1,046,868
Mozambique	13,833,586	1,286,161	1,009,317	0	9,729,293	39,293,813	0	n.a.	7,267,865	**163,100,675**	35,106,269	15,879,784
Uganda	42,372,003	3,376,698	36,680,242	4,424,621	19,824,309	0	44,342,876	0	34,919,679	**226,770,473**	26,116,695	47,835,568
Tanzania	7,292,938	598,900	3,175,056	0	3,433,372	70,781,762	5,357,016	n.a.	5,169,052	**253,765,981**	35,412,688	7,963,036
Zimbabwe	35,710,509	1,685,083	0	0	n.a.	10,623,961	n.a	n.a.	0	**52,795,374**	18,938,406	31,647,486
Lower-middle-income countries												
Kenya	144,603,851	10,477,064	11,219,264	0	226,129,240	0	89,037,711	n.a.	92,154,809	**674,250,737**	152,310,361	116,208,273
Lesotho	50,694,268	3,057,221	0	0	1,817,686	0	0	n.a.	40,404,416	**102,101,635**	n.a.	n.a.
Nigeria	123,946,158	9,819,442	0	213,804,800	155,173,666	67,048,691	134,816,685	41,181,447	61,196,796	**1,678,586,031**	16,288,281	0
Swaziland	32,128,818	693,315	0	26,178,551	0	16,889,249	0	4,064,522	15,356,386	**114,058,678**	n.a.	n.a.
Zambia	16,350,025	1,278,110	3,114,290	7,027,191	0	68,248,827	0	n.a.	0	**217,804,380**	18,567,945	22,079,281
Upper-middle-income countries												
Botswana	315,948,052	14,128,478	0	527,198,394	273,135,411	0	0	14,386,505	0	**1,779,276,710**	0	216,418,647
Namibia	181,203,580	8,983,056	0	85,723,694	14,961,072	0	0	n.a.	31,841,130	**362,037,531**	0	161,999,829
South Africa	2,040,790,395	61,494,978	0	0	337,351,516	1,378,692,629	0	99,860,577	629,861,977	**4,953,607,750**	0	0
Total LICs	131,159,138	9,578,984	64,336,828	28,338,662	43,489,557	149,152,499	51,376,118	11,280,604	66,156,129	**963,204,386**	230,504,760	136,095,325
Total LMICs	367,723,120	25,325,153	14,333,555	247,010,542	383,120,593	152,186,768	223,854,396	45,245,969	209,112,407	**2,786,801,461**	187,166,586	138,287,554
Total UMICs	2,537,942,027	84,606,512	0	612,922,088	625,447,998	1,378,692,629	0	114,247,082	661,703,107	**7,094,921,991**	0	378,418,477
Total	3,036,824,285	119,510,649	78,670,382	888,271,292	1,052,058,148	1,680,031,895	275,230,514	170,773,654	936,971,643	**10,844,927,838**	417,671,345	652,801,356

Note: All monetary figures are in 2014US$. Maximum potential public spending is a cumulative value if all the sources are increased simultaneously, which is why it is more than the sum of each source. To avoid double-counting, where revenue generation was increased to the norm and health reprioritised, we did not include the additional health-earmarked sources in this cumulative sum.
LICs: Low-income countries; LMICs: Lower-middle-income countries; UMICs: Upper-middle-income countries.

Table 4
Regression analyses (OLS) of Public HIV spending per PLHIV (US$) by source of fiscal space.

	Ordinary least squares regression Models						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Control variables							
HIV prevalence	−0.172	−0.221*	−0.191	−0.181	−0.158	−0.254**	−0.782***
	(0.123)	(0.128)	(0.126)	(0.124)	(0.127)	(0.124)	(0.084)
Control of corruption index	0.240	0.245	0.186	0.077	0.224	0.512**	0.282**
	(0.250)	(0.249)	(0.263)	(0.265)	(0.255)	(0.249)	(0.142)
International HIV spending per PLHIV	0.212**	0.214**	0.198**	0.190**	0.202**	0.132	0.101*
	(0.094)	(0.093)	(0.097)	(0.093)	(0.095)	(0.094)	(0.054)
Year of spending data	0.036	0.050	0.059	0.064	0.045	0.028	−0.036
	(0.087)	(0.088)	(0.088)	(0.087)	(0.090)	(0.084)	(0.050)
Reference: West & Central Africa							
East & Southern Africa	0.328	0.375	0.484	0.396	0.286	0.185	0.108
	(0.354)	(0.355)	(0.366)	(0.353)	(0.372)	(0.333)	(0.202)
Asia & Pacific region	0.019	0.088	−0.108	0.026	−0.034	−0.156	−0.040
	(0.403)	(0.406)	(0.408)	(0.399)	(0.415)	(0.387)	(0.229)
Latin America region	1.310***	1.309***	1.350***	1.135***	1.374***	1.017**	0.708***
	(0.428)	(0.427)	(0.425)	(0.446)	(0.438)	(0.429)	(0.247)
Caribbean region	−0.359	−0.328	−0.243	−0.353	−0.368	−0.473	−0.123
	(0.543)	(0.541)	(0.543)	(0.537)	(0.562)	(0.503)	(0.308)
Easter Europe & Central Asia region	0.687	0.521	0.663	0.706	0.764	0.408	0.345
	(0.485)	(0.500)	(0.485)	(0.481)	(0.495)	(0.468)	(0.276)
North Africa & Middle East Region	−0.586	−0.715	−0.245	−0.575	−0.493	−0.524	0.148
	(0.539)	(0.547)	(0.559)	(0.536)	(0.553)	(0.551)	(0.311)
Sources of fiscal space (explanatory variables)							
GDP per capita	1.091***	1.007***	1.050***	1.116***	1.137***	1.017***	0.994***
	(0.153)	(0.166)	(0.157)	(0.153)	(0.216)	(0.149)	(0.087)
Government revenue, excl. grants as % GDP		0.443					
		(0.350)					
Gross government debt as % GDP			−0.162				
			(0.207)				
Government health expenditure as % total government expenditure				0.400*			
				(0.251)			
Out-of-pocket health expenditure per capita					−0.071		
					(0.181)		
Non-drug cost per person on ART						0.105	
						(0.118)	
Public HIV spending as % of government health expenditure							0.757***
							(0.058)
Constant	−78.508	−107.211	−124.623	−134.622	−97.565	−64.140	68.346
	(175.606)	(176.421)	(176.942)	(175.506)	(180.588)	(168.128)	(100.270)
Observations	92	92	87	91	90	86	92
R^2	0.733	0.739	0.743	0.743	0.733	0.785	0.915

For the regressions the dependent variable and independent variables with monetary values or proportions were transformed into natural logarithmic form. The numbers in the cells are regression coefficients (standard errors). Significance levels are denoted as * for $p < 0.10$, ** for $p < 0.05$, *** for $p < 0.01$.
Each model tests the relationship with a different fiscal lever: (1) economic growth; (2) general revenue generation; (3) borrowing; (4) health prioritisation; (5) earmarked health revenue through risk-pooling scheme; (6) technical efficiency gains in the HIV programme based on ART programme efficiency; (7) HIV prioritisation in health.

Table 5
Relationship between Public HIV spending per PLHIV and each fiscal lever with different estimation methods.

Fiscal space policy options	OLS	Quantile regressions			Neighbour (hood) models		
		25th percentile	50th percentile	75th percentile	Pair FE	Random pair FE	Neighbour-hood FE
GDP per capita	1.091***	1.207***	1.102***	0.754***	1.168***	1.190***	1.246***
	(0.153)	(0.290)	(0.183)	(0.172)	(0.174)	(0.170)	(0.150)
Government revenue, excl. grants as % GDP	0.443	0.312	0.242	0.486	0.850**	0.845**	0.825**
	(0.350)	(0.677)	(0.452)	(0.411)	(0.421)	(0.355)	(0.395)
Gross government debt as % GDP	−0.162	−0.065	−0.022	−0.074	−0.0758	−0.00471	−0.145
	(0.207)	(0.301)	(0.358)	(0.436)	(0.194)	(0.162)	(0.182)
Government Health Expenditure as % Government Expenditure	0.400*	0.189	0.419***	0.675***	0.199	0.284	0.229
	(0.251)	(0.466)	(0.337)	(0.223)	(0.206)	(0.222)	(0.197)
Out-of-pocket health expenditure per capita	−0.071	−0.002	0.035	−0.144	−0.157	−0.107	−0.107
	(0.181)	(0.332)	(0.220)	(0.197)	(0.165)	(0.159)	(0.168)
Non-drug cost per person on ART	0.105	0.045	−0.024	0.146	0.182	0.124	0.233**
	(0.118)	(0.165)	(0.166)	(0.127)	(0.127)	(0.108)	(0.116)
Public HIV spending as % of GHE	0.757***	0.851***	0.783***	0.812***	0.715***	0.688***	0.758***
	(0.058)	(0.068)	(0.074)	(0.088)	(0.111)	(0.117)	(0.0767)

The numbers in the cells are regression coefficients (standard errors). Significance levels are denoted as * for $p < 0.10$, ** for $p < 0.05$, *** for $p < 0.01$.

If past behaviours of low and middle-income countries continue into the future, we found that fiscal space may only be realistically created from economic growth, greater health or HIV prioritisation. For these prioritisation measures, the resulting increase in public HIV expenditure would be less than has been assumed, and a larger share of health in the national budget and of HIV in the health budget have not been achieved simultaneously. Comparing the maximum annual fiscal space estimates under the normative approach to the fiscal space estimates based on the responsiveness found in the OLS models, with only GDP per capita, health and HIV prioritisation being brought up to their forecasted levels or targets, we find between 4% and 80% less potential public finance in the selected countries (median 57% less) (see Fig. 1).

When comparing both the normative and empirical estimates of fiscal space for HIV to the fiscal needs, we found that Malawi, Uganda, Zimbabwe, Tanzania, Mozambique, Lesotho and Zambia would not be able to fund their HIV programmes in either scenario. On the other hand, under the normative approach, Kenya, Nigeria, Ethiopia, and Swaziland could cover this cost in principle, but not under the empirical approach. In this case, only South Africa, Botswana and Namibia could meet this fiscal need under both scenarios.

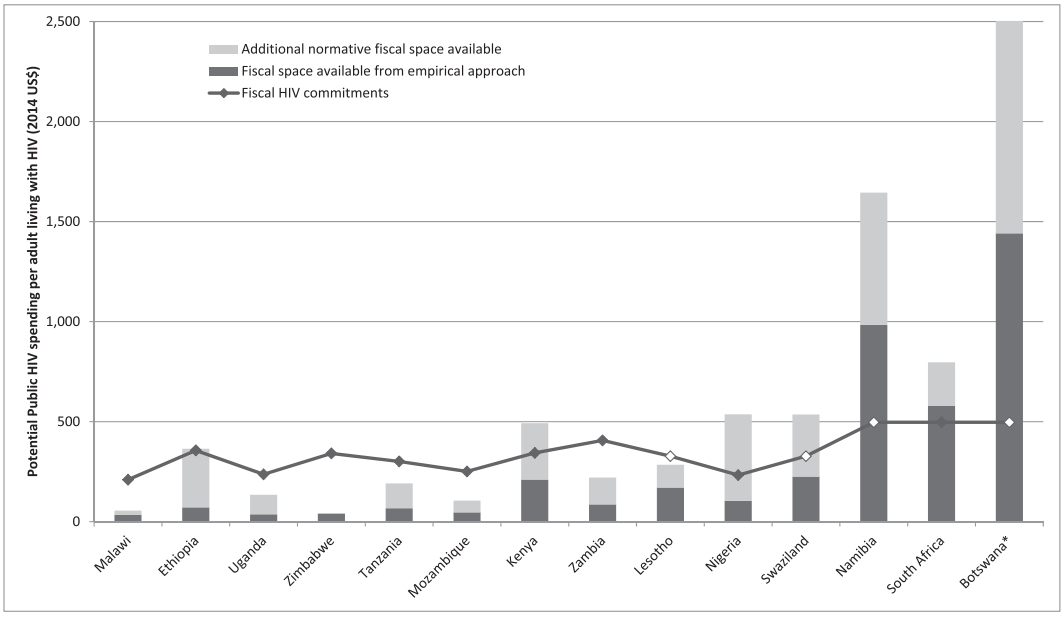
4. Discussion

Our analysis suggests that the most HIV-affected lower-income countries in sub-Saharan Africa will not be able to generate sufficient domestic public resources in the medium-term, even if they take very bold measures to improve revenue generation, reallocate resources and maximise efficiency in line with their economic capacity. The shortfall between the optimistic normative estimate of potential financing and recent conservative estimates of financial obligations (with continued scale-up) remains considerable (Hontelez et al., 2016). Some of the lower-middle income countries could cover these costs in principle if they would adopt normative targets and tap more innovative fiscal levers. However, when past HIV financing behaviour (which may be rational) is taken into account, even they could not pay for their HIV programmes. Only the upper-middle income countries could potentially shoulder the fiscal costs of their responses in the near future. Our findings therefore support the broad global policy response to increasingly target international financing.

Our normative estimates of fiscal space are substantially higher than previous studies, because we include a more comprehensive (but still non-exhaustive) set of fiscal policy options, including some unconventional ones. This provides an optimistic picture, with significant effort required to realise some of this potential. We consider borrowing as a serious policy option; unpack and quantify some health-earmarked sources; as well as efficiency gains from within and beyond the HIV programme. When comparing the same sources, we generally find similar potential as the most recent study by Resch et al. (2015), although our estimates of fiscal space from economic growth and general revenue generation tend to be somewhat lower, possibly due to differences in data sources.

When we constrain our estimates by the empirical models of which levers have been related to public HIV spending in the past, they become lower than previous estimates. This approach highlights that achieving various norms/benchmarks is not likely to automatically translate into a real proportionate increase in HIV spending; in part due to the interaction between different fiscal policies. Therefore, focusing on reprioritising resources towards HIV and/or health alone, based on targets that have already proven to be politically challenging – may end up yielding less additional finance than anticipated.

It should be noted that our findings have several limitations. First, the quality of HIV spending data is weak. They may partly reflect spending where government is the agent rather than the source; capture disbursements rather than expenditures; and identify only HIV-labelled expenditures rather than overall expenditures for HIV. Secondly, we implicitly assume an immediate policy decision, no transaction costs and the absorptive capacity to implement fiscal targets (David, 2009). This is unlikely, particularly in areas like converting out-of-pocket expenditures into social health insurance premia, and hence we may overestimate the



* Botswana's additional space extends beyond the figure to US$ 5,270, but was capped for legibility.

Note: Fiscal commitments are average estimates over the same period from Hontelez et al (2016), except for Botswana, Namibia, Swaziland and Lesotho. For these countries we use averages from the countries in the same income categories. The normative estimate of potential public HIV spending excludes the potential savings from non-HIV spending.

Fig. 1. Comparing the potential fiscal space for HIV from the extended normative approach to the empirical approach.

short-term potential from these sources. Similarly, although our empirical analysis was designed to incorporate the uncertainty around adjustments between fiscal policies, we have not incorporated the uncertainty around the feasibility of achieving each norm. Some of the 'global' norms we used are quite conservative, such as economic growth and government revenue generation (McIntyre and Meheus, 2014), whereas others are considerably more optimistic, like the Abuja target, or the share of out-of-pocket expenditures in total health expenditures. Still, there are countries among the 14 that achieved or surpassed each one of them.

A third limitation stems from relying on global analyses to draw conclusions for the sub-Saharan African sub-group, and past spending data to predict future spending. Indeed, it is reasonable to expect that the 14 most HIV-affected countries are qualitatively different from other low and middle-income countries, just as governments may make decisions differently going forward, especially if donors start changing their financing patterns (Dieleman et al., 2014; Kates et al., 2014).

Finally, an important limitation in our empirical models is a potential endogeneity bias from our cross-sectional dataset. Although we used similar methods adopted in previous studies on the determinants of HIV and health expenditures (Avila et al., 2013; Fan and Savedoff, 2014; Gerdtham et al., 1992; Xu et al., 2011)-albeit for panel datasets - there is a risk when making causal inferences. We applied the neighbour fixed effects approach (Colombo et al., 2014) to address the potential omitted variable bias, but neither estimation method addresses the potential bi-directionality between certain explanatory variables and public HIV spending. We considered this bias for each of the variables of interest. Where they may influence our estimates, it is likely to be by attenuating the impact of fiscal adjustments and overestimating coefficients. This would imply that our adjusted 'real world' estimates are still overestimates of the real fiscal policy effect on pubic HIV spending, but they would be closer than current normative estimates. The only exception would be GDP per capita, where we find greater responsiveness, but existing evidence does not support such macroeconomic impacts of HIV (Beegle and De Weerdt, 2008), even in high burden countries. The other variables of interest with a more important potential bidirectionality bias that could affect our findings are out-of-pocket health expenditures and the non-drug cost per person retained on ART. For both measures, the insignificant relationships we found do not rule out the existence of a relationship in either direction, and their exclusion from the empirical estimates may underestimate their potential.

Despite these limitations, our findings have some clear specific policy implications. Our empirical analysis suggests that governments have not used many of their domestic fiscal levers to increase HIV allocations. Country-level consultations indicate that domestic resource mobilisation has not been a priority in certain countries, given the availability of large external HIV funds and varying perceptions as to their likely decline (Katz et al., 2014a). This could further explain why increasing the tax base was not consistently associated with past public HIV spending, as external HIV financing may have been easier for governments to mobilise.

Only economic growth, health and HIV prioritisation appear to have consistently influenced national levels of HIV expenditure. Strong economic growth in Africa is being hailed as a major source of domestic financing, but although we find that public HIV spending is very responsive to income (similarly to health expenditure (Fan and Savedoff, 2014; Xu et al., 2011)), the magnitude of the increase from this source alone is relatively small in the medium-term (Elovainio and Evans, 2013). Nonetheless, it represents a relatively reliable source that could sustain and multiply the impact of other measures in the long run. With strong political will, it may also be used more proactively to ring-fence resources for HIV services through a more than proportionate allocation formula, where desirable.

Countries could generate significant resources by reprioritising health in the general budget and HIV in the health budget (Resch et al., 2015), even though their independent and joint potential may have been overestimated to date (Tandon et al., 2014). Moreover, greater HIV reprioritisation could risk crowding out other areas of health investment (McIntyre and Meheus, 2014), although the evidence on this is mixed (Samb et al., 2009). It may be particularly difficult to further prioritise HIV in contexts where external financing is declining, without a simultaneous increase in other fiscal space sources, as our empirical models suggest that international financing for HIV may have indirectly contributed to greater HIV prioritisation in health, through some crowding-in effect. This contrasts with previous studies that find evidence of fungibility in the health sector more generally, whereby increases in development assistance for health channelled through governments have been associated with reductions in public spending on health from public sources (Harper, 2012; Lu et al., 2010; Xu et al., 2011). Even though it suggests care has to be taken to ensure appropriate co-financing arrangements, this could bode well for future agreements between governments and donors, such as the Global Fund's counterpart financing requirements or the PEPFAR partnership frameworks. However, there may be external explanations for this finding. Alternative interpretations include that much of HIV-related aid may have been channelled to NGOs and therefore not displaced government spending (Lu et al., 2010); or aid may be given to countries that already prioritise HIV more and have better governance, as we find in our analysis. This may also be a measurement error, where some reported public spending may include external aid channelled through government budgets.

In terms of the new areas of financing identified, our analysis suggests that several are worth further exploration. Concessional borrowing has potential in principle, assuming the returns to these investments outweigh the costs of borrowing. Yet, this has not been a politically attractive option for direct HIV spending or for freeing up government resources. This could have several reasons, including that governments may not view HIV spending as an investment with financial returns, despite the 15:1 return estimated by UNAIDS (UNAIDS, 2014a). Moreover, this ability to borrow could also be a reflection of recent debt relief in some countries resulting in low debt stocks, rather than sound debt management. Yet, given the magnitude of future HIV treatment obligations, the case could potentially be made for more concessional HIV borrowing, especially in resource-rich countries (Ncube and Brixiová, 2013). Further macroeconomic modelling is required to estimate the dynamic feedback of HIV investments on fiscal space.

We also find substantial potential from earmarked sources for health, suggesting that those focusing on HIV have a strong mutual interest with those working on general health sector financing. Converting high levels of out-of-pocket expenditure into stable and non-regressive public revenue through social health insurance could mobilise considerable resources for HIV, and other health programmes, in Kenya, Nigeria and Uganda, for example. But the institutional reforms required would be substantial and time-consuming. The government of Kenya has recognised this potential and decided to increase premia for the National Hospital Insurance Fund by 25% to raise domestic resources for HIV and non-communicable disease by a projected US$ 120 million over 5 years (Katz et al., 2014a). This is considerably less than our estimated US$ 89 million per year, but is likely a more realistic estimate of gradual revenue generation through this mechanism. Earmarked increases in alcohol taxes could also generate resources, in addition to their expected double dividend of reducing HIV transmission and improving treatment efficacy (Hill and Sawyer, 2012; Vassall et al.,

2012). Kenya and Benin have also considered HIV-earmarked taxes on airline tickets and mobile phone usage, respectively (Katz et al., 2014a). However, any earmarking may reduce fiscal flexibility and allocative efficiency in public finance more broadly (Kutzin, 2013; Tandon et al., 2014); and may not be acceptable to ministries of finance. Moreover, it is quite likely that increased revenues from HIV-earmarked sources may in practice be accompanied by a reduction in allocations from general government revenue to HIV (McIntyre and Meheus, 2014; Tandon and Cashin, 2010; Tandon et al., 2014). In the extreme case of Kazakhstan, for example, following the introduction of a payroll tax earmarked for health, the subsequent general tax allocation to health reduced by more than the additional payroll tax, leading to a net reduction in health resources (Elovainio and Evans, 2013). Such mechanisms therefore might not generate any additional resources in the absence of credible commitment mechanisms.

Our analysis confirms the potential of technical efficiency gains; and supports the global policy emphasis on improving HIV programme efficiency for a sustained HIV response. Our estimates for South Africa, for example, suggest that there could be more to gain from the latter than from a greater prioritisation of health. However, the empirical data does not confirm our input-oriented measure of technical efficiency as a determinant of past public HIV spending. This may be because higher unit costs can influence spending in two opposite ways: by increasing spending to get the same output, or decreasing government's willingness to allocate resources to an inefficient programme. Also, this measure does not sufficiently capture price differentials or site-level heterogeneity. Nonetheless, it was expected to broadly reflect in aggregate terms the relative room for efficiency improvements, and interestingly, our normative estimates of potential efficiency gains (29% of current spending) – are more conservative than recent estimates using more sophisticated Data Envelopment Analysis techniques (53%) (Zeng et al., 2012, 2016). Our results are sensitive to which country is considered the best performer, particularly for the upper-middle-income country category, which is not surprising given the large unexplained variation in ART unit costs found in most empirical studies (Siapka et al., 2014). Still, further research is needed to develop country-level measures of programme efficiency and understand its determinants.

For low-income countries, we found substantial gains from more effective complementary investments in health systems and social development. In these highly resource-constrained settings, the opportunity cost of increased HIV financing may be particularly high and synergistic investments all the more important. Our findings cautiously suggest that the HIV budget holder could see financial value in contributing to human resource expansion or reduced undernourishment, to avert direct HIV expenditures. This does not necessarily mean that they should do so – the cost of this investment would first need to be determined and the net benefit of the investment established. Effective fiscal space would only be created if the investment required was more efficient than a direct investment in HIV services. However, given that both these investments have wider benefits than HIV alone, a co-financing approach that seeks to maximise HIV and other outcomes may be considered (McIntyre and Meheus, 2014; Remme et al., 2014). Some argue that the HIV sector has made only marginal short-term investments in health system complements that could be reaching their limits (Bowser et al., 2014). It may be more rational for HIV budget holders to consider co-investing in these binding constraints. However, more research is needed in this area to explore which non-HIV investments could contribute most to the efficiency of HIV programmes and what institutional mechanisms could incentivise cross-sectoral and cross-disease governance and financing.

In conclusion, we present a more realistic, but still optimistic picture of improved domestic financing for HIV that will require the HIV community to engage with broader public finance and social development agendas. International funders can support this effort with a more coherent engagement across health and social development investments, a continued focus on efficiency, and a longer term approach to co-financing national HIV responses within broader health financing frameworks. With the ongoing dialogue on how to finance the sustainable development goals, it will be important that those working in HIV join the call for increased health prioritisation in the context of universal health coverage, and work to identify tailored country-specific approaches to proactively leverage broader development investments. This will be central to expanding access to HIV prevention and treatment in a way that is sustainable and in line with the post-2015 development agenda.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2016.09.027.

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