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HIV/AIDS as a Fiscal Liability

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Abstract: The costs of HIV/AIDS programs are significant from a macroeconomic or fiscal perspective in a number of countries. Assessing the fiscal implications is complicated by the long lags between infection and the need for HIV/AIDS-related services, and the long duration over which these services (notably treatment) are required. The paper interprets the fiscal costs of HIV/AIDS programs as quasi-liabilities, which are incurred by HIV infections and are paid off as HIV/AIDS-related services are delivered. On the microeconomic level, the analysis yields estimates of the costs incurred by single HIV infections, which – together with other criteria – can be used in assessing the effectiveness of HIV/AIDS program allocations. On the macroeconomic level, the analysis highlights the large magnitude of the HIV/AIDS quasi-liability (according to criteria for the sustainability of public debt), and quantifies the fiscal savings achieved or projected as a consequence of declining HIV incidence.

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Contents Page

Tables

Figures

I. Introduction

The present paper[1] builds on the experience of providing economic and fiscal analysis policy advice to governments in Southern Africa, including several countries facing a large HIV/AIDS burden. In addition to the challenges of managing the policy response to the epidemic, the impact of HIV/AIDS (at least in these severely affected countries) has policy implications across the board. The macroeconomic, fiscal, and development consequences of HIV/AIDS – e.g., the impact on economic growth, the costs and the financing of the national response to HIV/AIDS, health outcomes, or household effects – modify key outcomes the government's development policy may be targeting, and affect the government's policy environment.

Against this background, the present paper deals with fiscal aspects of HIV/AIDS. Specifically, it builds on two observations: (1) Most of the fiscal costs of HIV/AIDS are ultimately the consequences of HIV infections. (2) HIV/AIDS involves long time lags between infection, development of full symptoms of AIDS, and the resulting demand for health and other services).

As a consequence, the impact of and the response to HIV/AIDS are long-term events, with implications for public services and public finance over the next decades. Current HIV/AIDS-related spending responds to a demand for HIV/AIDS-related services which has been incurred (by new infections) over the last two decades, while current policy outcomes and epidemiological trends (notably, the number of new infections) have implications for the demand for public services over the next decades.

This means that, for the analysis of the fiscal consequences of HIV/AIDS (the magnitude and sustainability of the fiscal burden, and viable financing strategies) and policy alternatives, the most common planning tools, focusing on the short- to medium-term, are insufficient (see Heller, 2003). Our analysis, interpreting the fiscal costs of HIV/AIDS as a quasi-liability, is intended to capture the long-term nature of the commitments implied by an HIV/AIDS program, improve the measurement of the evolving fiscal burden (and inform choices between alternative HIV/AIDS-related interventions), and directly link the costs of HIV/AIDS programs to the underlying profile of new HIV infections. Most importantly, we do the following:

- Estimate the spending commitments which – under the parameters of the national HIV/AIDS program – are incurred by a new HIV infection.
- Estimate the evolving fiscal burden of HIV/AIDS as a quasi-liability, with new commitments incurred by HIV infections, and the quasi-liability being "paid off" as the HIV/AIDS-related services are delivered.

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[1] The current paper draws from and builds on work conducted by the author in the context of a work program assessing the "Fiscal Dimension of HIV/AIDS," funded by the World Bank and managed by Elizabeth Lule. However, the findings, interpretations, and conclusions expressed in this paper are the author's, have not been subject to review by the World Bank, and should not be attributed to the World Bank.

For policy, three outcomes of our analysis are particularly relevant:

- The estimates of the fiscal quasi-liability implied by the HIV/AIDS program provide a summary measure of the fiscal burden of HIV/AIDS that takes into account the level and the persistence of HIV/AIDS-related spending, and can be used to assess the sustainability of the fiscal position using tools developed for the sustainability of public debt.
- The estimates of the costs incurred by a new infection yield a tool to assess the cost-effectiveness of prevention measures and program allocations, at least from a fiscal angle.
- The estimates of the evolving fiscal quasi-liability implied by the HIV/AIDS program, together with data on current spending, enable a ranking of alternative HIV/AIDS-related policies from a fiscal perspective.

Our analysis sets out (Section II) with a review of HIV/AIDS-related spending across 14 countries in Southern and Eastern Africa, intended to illustrate the scale of the fiscal dimension of HIV/AIDS and some of its determinants. Section III introduces and discusses the concept of HIV/AIDS as a fiscal quasi-liability, and explains the value-added we derive from this analysis. Section IV explains the methodology underlying our estimates, regarding the liability incurred, under the national HIV/AIDS program, by a single infection, and explaining our macroeconomic analysis. Section V motivates the country coverage of our more detailed analysis, which draws on more detailed studies for four countries (Botswana, South Africa, Swaziland, and Uganda), and discusses data issues. Section VI presents a quantitative analysis of the fiscal costs of HIV/AIDS as a fiscal quasi-liability for these four countries. Section VI concludes.

II. Background

To provide some context for our analysis of the fiscal consequences of HIV/AIDS, we review cross-country data on the scale of HIV/AIDS-related spending. Table 1 summarizes the most recent data on the scale of HIV/AIDS-related spending for 14 countries in Southern and Eastern Africa.[2] These countries include the countries facing the highest HIV prevalence globally, but also a number of countries with relatively low HIV prevalence to highlight the differences across countries in the region. Across the 15 countries covered, total HIV/AIDS-related spending for the years covered accounts for US$4.7 billion (1.0 percent of GDP), corresponding to US$15 per capita. The 15 countries represent a significant share of global HIV/AIDS spending (about 30 percent, and one-third of external HIV/AIDS financing).[3] External financing accounts for over 40

[2]See UNAIDS (2010) for more comprehensive data on HIV/AIDS-related spending and funding sources across countries.

[3]According to UNAIDS (2010), HIV/AIDS spending increased from US$ 13.7bn to US$ 15.9bn, while external support declined slightly from US$ 7.7bn to US$7.6bn, between 2008 and 2009. Most of our data

percent of total spending for the years shown (and 80 percent excluding South Africa), this average masks very large differences across countries. While external support was around 30 percent of GDP in Botswana and South Africa, it accounts for more than 95 percent of HIV/AIDS-related spending in Malawi, Mozambique, Tanzania, and Zambia.

Table 1. Selected Countries: HIV/AIDS Spending and Financing

		HIV Prevalence	HIV/AIDS Spending			External Financing	GDP per capita
Country	Year	(Percent)	Total (US$ mn)	Percent of GDP	Per capita (US$)	(percent of Total)	(US$)
Angola	2009	2.0	33.7	0.05	1.9	n.a.	3,972
Botswana	2008	24.9	348.1	2.6	194.4	32.1	7,552
Kenya	2008	6.3	687.0	2.6	19.5	86.0	755
Lesotho	2008	23.6	56.4	3.6	22.9	53.1	645
Madagascar	2008	0.2	12.0	0.1	0.6	54.7	468
Malawi	2008	11.2	107.4	2.6	7.8	97.6	298
Mozambique	2008	11.4	146.4	1.5	7.1	95.6	478
Namibia	2007	14.3	18.5	0.2	9.1	49.2	4,341
South Africa	2009	17.8	2,088.0	0.7	42.3	27.3	5,824
Swaziland	2006	25.7	48.5	1.8	47.7	61.3	2,698
Tanzania	2008	5.8	465.0	2.3	11.7	98.1	519
Uganda	2008	6.4	302.7	1.8	8.9	88.5	504
Zambia	2008	13.6	279.3	2.6	23.5	97.1	901
Zimbabwe	2009	14.3	54.1	1.2	4.6	69.8	375
Total (latest years)		11.6	4,647.3	1.0	17.8	43.3	1,859

Source: UNGASS Country Reports 2010 for HIV spending, augmented by domestic sources for Swaziland and Zambia, IMF (2010) for GDP.

Relating HIV/AIDS expenditures to GDP gives an indicator of the scale of the financial burden relative to economic capacities. While countries with high HIV prevalence[4] tend to face a steeper challenge in this regard, the burden is also very high in a number of low-income countries with much lower HIV prevalence. For example, among the countries with the highest HIV prevalence, spending relative to GDP (3.6 percent) is the highest in Lesotho, which has a much lower level of GDP per capita than Botswana or Swaziland. The level of spending, at 2.6 percent of GDP, is about the same in Botswana (HIV prevalence: 25 percent) and Malawi (HIV prevalence: 11 percent), and almost as high (2.3 percent of GDP) in Tanzania (HIV prevalence: 6 percent). This primarily reflects the very large differences in economic capacities – the level of GDP per capita in Malawi and Tanzania is only 4 percent and 7 percent, respectively, of the level of GDP per capita in Botswana.

In terms of domestically financed HIV/AIDS-related spending, the highest burden occurs in the countries facing the highest HIV prevalence (1.7 percent of GDP in Botswana and Lesotho, 0.7 percent of GDP in Swaziland, 0.5 percent of GDP in South Africa). While the rate of external financing among the 14 countries covered is the lowest in Botswana and South Africa, these countries – in light of their high level of economic development – do not receive significant external aid for purposes other than the HIV/AIDS program. External assistance thus is the dominant factor in financing HIV/AIDS spending in low-income countries, and provides partial insurance to middle-income countries facing a large disease burden.

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relate to fiscal year 2008/09, but some to other periods. With the data at our disposal, we therefore cannot calculate precise ratios.

[4]Unless stated otherwise, "HIV prevalence" refers to the population of ages 15-49 throughout this paper.

Table 2. Selected Countries: Total and Domestically Financed HIV/AIDS Spending

Country	Year	Total HIV/AIDS Spending (% of GDP)	Domestically Financed HIV/AIDS Spending (% of GDP)	Domestically Financed HIV/AIDS Spending (% of Govt. Exp.)	Total Health Spending (% of GDP)	Public Health Spending (% of GDP)
Angola	2009	0.05	n.a.	n.a.	2.7	2.2
Botswana	2008	2.6	1.7	4.4	5.6	4.2
Kenya	2008	2.6	0.4	1.4	4.5	1.7
Lesotho	2008	3.6	1.7	2.6	6.4	3.6
Madagascar	2008	0.1	0.1	n.a.	4.5	3.1
Malawi	2008	2.6	0.1	0.2	9.7	5.8
Mozambique	2008	1.5	0.1	0.2	5.6	4.3
Namibia	2007	0.2	0.1	0.4	6.7	3.6
South Africa	2009	0.7	0.5	1.6	8.3	3.4
Swaziland	2006	1.8	0.7	2.1	5.9	3.8
Tanzania	2008	2.3	0.0	0.2	5.1	3.4
Uganda	2008	1.8	0.1	0.4	6.3	1.4
Zambia	2008	2.6	0.0	0.2	6.0	3.7
Zimbabwe	2009	1.2	0.4	1.5	n.a.	n.a.

Sources: See Table 1; additionally, various IMF country reports for government expenditures.

To appreciate the fiscal challenges posed by the response to HIV/AIDS, it is also useful to relate the scale of HIV/AIDS-related spending to the scale of government operations. We see that domestically financed HIV/AIDS spending absorbs between 0.2 percent and 4.4 percent of government spending. As government spending relative to GDP tends to be lower in low-income countries than in middle-income countries,[5] the differences across countries by this count are smaller than the differences in spending relative to GDP. Finally, it is also instructive to compare the scale of HIV/AIDS-related spending to the level of health expenditures – because a substantial part of HIV/AIDS-related spending occurs in the health sector (but not necessarily through public health services), and because it provides a measure of the magnitude of HIV/AIDS-related spending against a major aspect of government operations. HIV/AIDS-related spending (including non-health spending) exceeds the equivalent of one-half of total health spending in two countries (Kenya, Lesotho), and exceeds 40 percent of total health spending in three more countries (Botswana, Tanzania, and Zambia).

A number of lessons can be drawn from the highly aggregate and cross-country data discussed above. (1) In many countries, the costs of HIV/AIDS programs are significant from a macroeconomic or fiscal perspective. (2) Principal determinants of the burden posed by the costs of HIV/AIDS, relative to economic or fiscal capacities, are the scale of the epidemic and the level of economic development. (3) The role of external financing differs across countries, including near-complete underwriting of the costs of an HIV/AIDS program in a number of low-income countries and partial support to a number of middle-income countries facing a very large disease burden, which otherwise receive very little external assistance.

[5]Primarily, this reflects that domestic revenues are lower (relative to GDP) in low-income countries. Consequently, government expenditures are between 18 percent of GDP and 28 percent of GDP for the low-income countries covered in Table 2 (with the exception of Lesotho, which receives large transfers through the Southern African Customs Union), and between 32 percent of GDP and 65 percent of GDP for the middle-income countries.

III. HIV/AIDS as a Fiscal Liability

Whether or not an analysis of the scale of HIV/AIDS-related spending such as the one above concludes that it is an issue that is significant from a macroeconomic and fiscal perspective in a particular country, an analysis current spending such as the one above cannot address many of the issues most pertinent for assessing the implications of HIV/AIDS for public finance, for several reasons.

- Most importantly, the commitments under an HIV/AIDS program are of a long-term nature. To assess the extent to which the costs of the response to HIV/AIDS absorb fiscal space, it is therefore necessary to understand whether the costs will increase or decrease over the coming years.
- The demand for HIV/AIDS-related services evolves subject to very long time lags, which can extend over decades. Typically, there are many years between infection and treatment need, and the costs of treatment or support to surviving dependents
- To assess the effectiveness of spending allocations in terms of their implications for fiscal space, or to understand the fiscal dimension of trade-offs implied by current policy choices or program alternatives, it is therefore necessary to capture the long-term fiscal implications of such choices.

Our analysis is designed to provide an assessment of the fiscal consequences of HIV/AIDS which adequately captures the long-term commitments made under the national HIV/AIDS policy. Central to our analysis is the interpretation of the **fiscal costs of HIV/AIDS as a fiscal quasi-liability.** With this term, we recognize that the fiscal costs of HIV/AIDS share characteristics with pension obligations and other social entitlements, which commit future government resources and – even if they do not constitute a formal debt – cannot easily be changed by the government ex post. As it can be a challenge politically to raise the retirement age or otherwise reduce the fiscal costs of pensions, it would be exceedingly difficult to seek to contain the fiscal costs of HIV/AIDS by reducing the attained coverage rates of HIV/AIDS-related services.[6]

Based on this premise, we follow three related lines of enquiry:

- **Estimating the overall fiscal burden of HIV/AIDS,** measured by the present discounted value of the costs of the HIV/AIDS program. The magnitude of the fiscal burden (or quasi-liability) provides a crude indicator of the sustainability of the fiscal costs of HIV/AIDS andcan be analyzed in similar ways as the sustainability of public debt. Considering that most of the costs of HIV/AIDS are ultimately caused by infections, and that projected infections increasingly are policy-dependent, it is useful to break down the fiscal burden in the costs already incurred by past infections (which translate into

[6]Our point here is intended only to underline why the fiscal costs of HIV/AIDS can be interpreted as a quasi-liability. There are other good reasons (medical, allocative efficiency, equity) why a policy of shifting around the coverage rates of HIV/AIDS-related services to contain fiscal costs is not attractive.

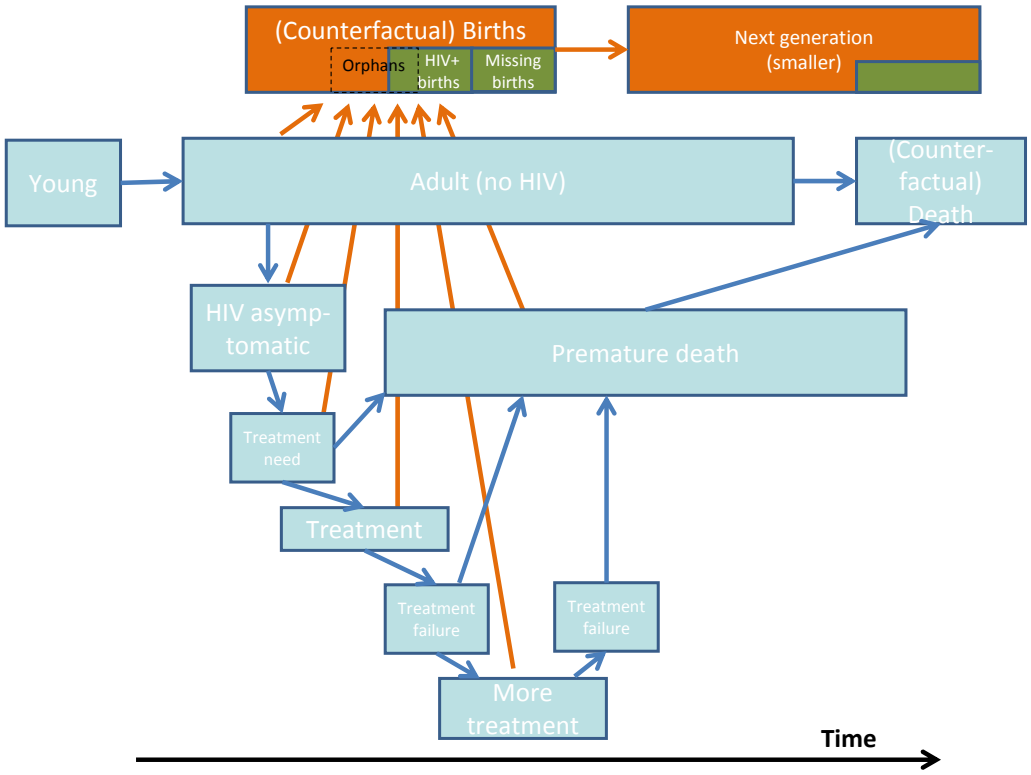
current and future demand for services), projected infections (possibly under different policy scenarios), and the costs of HIV/AIDS not directly dependent on HIV incidence (e.g., prevention programs targeting the entire population).

- **Measuring the costs incurred by a single infection.** A new HIV infection translates into demand for HIV/AIDS-related services over the following years or decades. Based on assumptions about the coverage rates of services and relevant unit costs, it is possible to estimate the expected costs incurred by an additional infection (or the costs saved by an infection prevented) over time, and the new liability incurred (measured by the present discounted value of the expected costs over time). The value of this liability is a critical input to assessing the effectiveness of the allocation of resources across interventions, as it is a necessary input to estimating fiscal trade-offs inherent in prevention investments.
- **Assessing the evolving fiscal burden of HIV/AIDS.** Based on the estimates of the overall fiscal burden of HIV/AIDS at the outset, the costs incurred by new infections, and projected actual spending, it is possible to estimate the change in the quasi-liability over time. This dynamic analysis provides a macroeconomic or fiscal perspective on the returns to prevention programs (in terms of a reduction in the fiscal quasi-liability), and adds to the assessment of the sustainability of the costs of the HIV/AIDS program (e.g., by showing whether the fiscal burden is increasing or declining).

IV. Methodology

The state space describing disease progression and related epidemiological and demographic events and states is illustrated in Figure 0. Much of it reflects the progression of the disease. As an HIV infection occurs, an individual enters the state of “HIV asymptomatic,” and eventually proceeds to “treatment need.” At this stage, further progression also depends on the policy context, as progression to “treatment” and “more treatment” depends on treatment coverage rates achieved or projected under the HIV/AIDS program. The parameters governing these transitions (except the treatment coverage rates were calibrated to match (or directly taken from) epidemiological estimates available for the respective countries.

Figure 0. State Space and Disease Progression



On death, an individual first enters the state of "premature death." This reflects the fact that – in the absence of an HIV infection – death would catch up with the individual at some stage (reflected in our state space as transition to "counterfactual death"). To estimate the impact of HIV/AIDS on the size of the population (especially the old population), it is therefore necessary to net out the counterfactual dead from the premature dead.

A special feature of our state space – reflecting the needs of our analysis conditioning the costs of HIV/AIDS on the number of adult infections over time – is the treatment of young people living with HIV/AIDS, which are modeled as a consequence of adult HIV infections (subject to certain parameters describing the coverage and quality of interventions to prevent mother-to-child transmission). To accommodate this, our state space vector includes pointers to capture the reduced number of births owing to lower fertility of women living with HIV/AIDS, the number of orphans, and the number of HIV-positive births. Not shown in Fig. 0, for reasons of tractability, is a similar module that describes the disease progression of young people living with HIV/AIDS.

Let y_t be the vector describing the state of an individual. For a new infection, the first element of the vector takes the value 1, and all other elements the value 0. (We denote this specific state vector indicating a new infection as i.) The progression of the individual across states is determined by the transition matrix M_t, so that

$$E\left(y_t\right) = M_t y_{t-1} \tag{1}$$

The matrix M_t is time-dependent, primarily because transition probabilities are policy-dependent – for example, the probability of transition to state "treatment" depends on the coverage rate of treatment.

For an individual infected at time s ($s < t$), the expected state at time t is given by

$$E\left(y_t \middle| y_s = i\right) = \left[\prod_{j=s+1}^{t} M_t\right] i \tag{2}$$

For our macroeconomic analysis, we adopt a deterministic version of Eq. (2), which maps the number of new infections in previous periods into a distribution across the state vector z_t (with identical structure as y_t, we just use different notation to distinguish from individual case).

$$z_t = in_t + \sum_{s=-\infty,}^{t-1} \left[\prod_{s+1}^{t} M_t\right] in_s \,, \tag{3}$$

where n_s stands for the number of HIV infections occurring in period s.[7] The vector describing the distribution across the state vector z_t maps into a demand for HIV/AIDS-related services d_t, with

$$d_t = Dz_t \,. \tag{4}$$

While the mapping from z_t into d_t is trivial in some cases (e.g., for state "treatment need"), the vector d_t would not normally have the same dimension as z_t – whereas some states (such as "premature death") do not map into a demand for services, others may be associated with more than one type of services.

In practice, most – but not all – HIV/AIDS-related spending is linked to one of the states spanned by vector z_t. For state-dependent services, we define policy rules in terms of coverage rates of the respective services. This is in line with the practice adopted in National Strategic Frameworks, which frequently express policy targets in terms of coverage rates, and offers a benchmark for extending our projections of the fiscal costs of HIV/AIDS – on top of assumptions

[7] In practice, the number of periods, rather than going back to the Big Bang, would be chosen with the assumed arrival of HIV/AIDS and the maximum survival time of individuals in mind.

of HIV incidence and the epidemiological model – beyond the time horizon covered by a National Strategic Framework.[8]

The national HIV/AIDS policy is therefore represented by a time-dependent policy vector p_t, which can be broken down into a vector $p_{1,t}$, which is of the same dimension as d_t and includes the coverage rates of the respective services, and $p_{2,t}$, which includes HIV/AIDS-related measures not directly tied to one of the states spanned by vector z_t (e.g., certain prevention measures targeting the entire population).

To obtain the estimated or projected costs of the national response to HIV/AIDS in period t, it is necessary to specify unit costs for the various interventions. These are given by vector u_t, of the same dimension as the policy vector p_t, and broken down into sub-vectors $u_{1,t}$ and $u_{2,t}$ in the same way as vector p_t. The costs of the national response to HIV/AIDS at a point in time y_t are then equal to

$$y_t = u_{1,t}^{'}(p_{1,t} \cdot d_t) + u_{2,t}^{'} p_{2,t} = u_{1,t}^{'}(p_{1,t} \cdot Dz_t) + u_{2,t}^{'} p_{2,t}. \quad (5)$$

Recalling that z_t is a distributed lag of past HIV infections, Eq. 5 breaks down the costs of the HIV program in period t into a component that reflects the costs of past infections, and a component that is not directly linked to the state vector z_t.

Together with the recognition that most of the costs of an HIV/AIDS program (especially in countries facing high HIV prevalence) is linked to z_t, Eq. 5 formalizes the observation that the costs of an HIV/AIDS program primarily reflect the costs of past infections, and that, conversely, the costs of current infections are primarily spread over future periods. For this reason, our analysis represents the fiscal burden of HIV/AIDS as a quasi-liability q_t, measured by the present discounted value of the current and future costs of HIV/AIDS.

There are at least two meaningful approaches to estimating the present discounted value of the fiscal costs of HIV/AIDS. First, one may take the present discounted value of projected sequence $\{y_s\}$, $s = t, t+1, ..., \infty$, i.e.,

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[8] Alternatively, one could assume that the number of people receiving a type of services (e.g., treatment) is fixed. In this case, an increase in the demand for treatment would translate into a decline in the coverage rate. When the *envelope theorem* applies, the consequences under the two alternative assumptions for the government's objective function would be equivalent, and the costs of an increase in the demand for services could be measured as if the government maintained the quality of services. The conditions under which the envelope theorem applies, however, may not apply. If the number of people receiving a certain type of services is fixed, and coverage rates decline as the demand increases, this would normally reflect short-run supply constraints. In this case, shadow prices and actual prices may diverge. Also, where external financing accounts for a large proportion of HIV/AIDS-related spending, relative prices may not accurately reflect the government's opportunity costs.

$$PDV\left(\{y_s\}\right) = E\sum_{s=t}^{\infty}(1+r)^{t-s}\,y_s\,. \tag{6}$$

The problematic aspect of this presentation is that it does include costs which have not yet been caused (by future infections) and which are still subject to policy interventions. Thus, it goes beyond what is commonly understood by a liability, and does not provide a clear link between *new* infections and the fiscal costs of HIV/AIDS.

To obtain a measure of the spending commitments through the national response to HIV/AIDS already incurred as a consequence of current and past infections, we define $z_{x,t}$ the state distribution at time x in consequence of HIV infections that have occurred through time t only, with $x > t$.

$$z_{x,t} = \sum_{s=-\infty}^{t}\left[\prod_{s}^{x} M_s\right] in_s\,, \tag{7}$$

Defining $y_{x,t}$ analogously as expenditures at time x incurred by HIV infections through time t, we have

$$y_{x,t} = u_{1,t}^{'}(p_{1,t}\cdot d_x) + u_{2,x}^{'}p_{2,x} = u_{1,x}^{'}(p_{1,x}\cdot Dz_{x,t}) + u_{2,x}^{'}p_{2,x}\,, \tag{8}$$

and

$$PDV\left(\{y_{x,t}\}\right) = E\sum_{s=t}^{\infty}(1+r)^{t-s}\,y_{s,t}\,. \tag{9}$$

A principal aspect of our analysis is the evolving fiscal burden, i.e. the change in the fiscal quasi-liability committed under the HIV/AIDS program as a consequence of new infections. The change in the state distribution $z_{x,t}$ in consequence of new infections at time t can be derived from Eq. 7 as

$$\frac{\partial z_{x,t}}{\partial n_t} = \prod_{t}^{x} M_s i\,. \tag{10}$$

From this, and Eqs. (8) and (9), it follows that

$$\frac{\partial PDV\left(\{y_{x,t}\}\right)}{\partial n_t} = E\sum_{s=t}^{\infty}(1+r)^{t-s}\frac{\partial y_{s,t}}{\partial n_t} = E\sum_{s=t}^{\infty}(1+r)^{t-s}u_{1,s}^{'}(p_{1,s}\cdot D\frac{\partial z_{s,t}}{\partial n_t})\,. \tag{11}$$

This equation is important for the evaluation of HIV/AIDS programs because is quantifies the value of the spending commitments over time incurred by one additional HIV infection at time t. The value of spending commitments incurred by all HIV infections occurring in period t is then

obtained (exactly, as our system is linear in the number of new infections) by multiplying $\partial PDV\left(\left\{y_{x,t}\right\}\right)/\partial n_t$ with n_t.

As explained elsewhere in this paper, the commitments under the HIV/AIDS program are of a long-term nature, and the quasi-liability arising from spending commitments under the national HIV/AIDS gives a more accurate indicator of the fiscal burden of HIV/AIDS than current spending does. To assess the *evolving* fiscal burden, we then need to obtain the change in the quasi-liability – while new infections add to this liability, we need to subtract the costs of programmed services when they are delivered, as these costs are then sunk and no longer affect the fiscal outlook. This is formalized in Eq. 12:

$$PDV\left(\left\{y_{x,t+1}\right\}\right)-PDV\left(\left\{y_{x,t}\right\}\right)=(1+r)\left[\left(E\sum_{s=t}^{\infty}(1+r)^{t-s}y_{s,t}\right)-y_{t,t}\right]+\frac{\partial PDV\left(\left\{y_{x,t+1}\right\}\right)}{\partial n_{t+1}}n_{t+1} \quad (12)$$

This means that the change in the fiscal quasi-liability between periods t and $t+1$ is obtained by (1) subtracting from the present discounted value in period t spending in period t (see term in square brackets); multiplying the balance with the discount factor $(1+r)$, as the remaining balance draws nearer; and adding the present discounted value of the spending committed under the HIV/AIDS program as a consequence of HIV infections which have taken place in period $t+1$.

Finally, our estimates of the fiscal costs of HIV/AIDS are embedded in a **macroeconomic model** (described in the relevant country studies). This principally captures the fact that reduced population growth translates into lower GDP growth. As our analysis focus on the evolving fiscal burden of HIV/AIDS relative to economic capacities (GDP or fiscal resources), it is necessary to capture this slowdown in the denominator. However, we do not include changes in government revenues arising from changes in GDP among the fiscal costs of HIV/AIDS. This reflects that a larger population and consequently higher GDP are also associated with a larger demand for public services (and higher government expenditures). Therefore, it would be misleading to count in such scale effects among the fiscal costs of HIV/AIDS (or in case of an infection prevented, as an item offsetting the HIV/AIDS program costs)

A number of limitations of our analysis should be noted. First, we do not model certain interactions between HIV prevalence (possibly depending on the applicable state) and the number of new infections. These effects may occur as an HIV infection reduces the number of potential infectees, while increasing the number of potential infectors. However, including such second-round effects would call for a much more complicated demographic and epidemiological model, and we would no longer be able to obtain the derivative of the costs of the HIV/AIDS with respect to the number of new infections analytically.

V. Country Coverage and Data Issues

To illustrate the applications of our analysis of HIV/AIDS as a fiscal liability, we provide estimates and projections from four country studies recently undertaken which cover a sufficiently long

time horizon. The four countries (Botswana, South Africa, Swaziland, and Uganda) were selected to represent a variety of situations regarding the domestic and external context. Although we focus on countries with high HIV prevalence (Botswana, South Africa, and Swaziland globally rank 2nd, 4th, and 1st in terms of HIV prevalence, according to UNAIDS (2010)), we also include Uganda (with an HIV prevalence of 6.5 percent as of 2009), as we noted above that the fiscal burden relative to GDP is very high in a number of low-income countries, and because it allows us to discuss the role of external support in a country where the financing of the HIV/AIDS program heavily depends on it.

In one country (South Africa), the estimates we draw on (from Haacker, 2011c) are based on and were developed in cooperation with an extensive analysis of the long-run costs and financing of HIV/AIDS in South Africa (Guthrie and others, 2010). Guthrie and others (2010) and develop three scenarios, we use their "Expanded NSP" scenario as an illustration of our analysis. The most significant difference between Guthrie and others (2010) and Haacker (2011c) regards the time horizon – Guthrie and others (2010) provide estimates through 2031, whereas Haacker (2011c) extends the projections over a longer time horizon.[9]While the work by Guthrie and others (2010) represents the state of the art in many regards, they nevertheless point to a lack of adequate data on the unit costs of HIV/AIDS-related services, coverage rates of services, and cost-effectiveness of various interventions, and note that this lack of data compromises the ability to inform key policy decisions.

For the other three countries, our estimates are based on cruder data. For Botswana and Uganda, Haacker (2011b) and Haacker (2011e) build on longer-term estimates and projections of the costs of the HIV/AIDS program from substantial studies of the macroeconomic impacts of HIV/AIDS in these countries (Jefferis, Siphambe, and Kinghorn (2006) for Botswana, and Jefferis and Matovu (2008) for Uganda). Building on these studies, Haacker (2011b) and Haacker (2011e) build updated projections, drawing – among other sources – on NACA (2008), NACA and UNAIDS (2010), and Government of Botswana (2010). In Swaziland, the data situation is more difficult. The latest published estimates of actual HIV/AIDS-related spending relate to fiscal year 2006/07 (NERCHA and UNAIDS, 2008); the projections in Haacker (2011d) build on cost projections prepared in support of an application to the Global Fund and targets and the national HIV/AIDS strategy for 2009-14 (Government of the Kingdom of Swaziland, 2009). Additionally, the projections are informed by sources not country specific, for example, regarding the projected costs of antiretroviral drugs.

Overall, the data available in the public domain regarding the costs of HIV/AIDS programs overall, or regarding the unit costs of interventions, are exceedingly weak (this is a shortcoming not specific to the country cases we use to illustrate our analysis). The weakness of the underlying data and the need to make projections beyond the time frame covered by a national HIV/AIDS program, of course, translates into a large margin of error for our estimates of the

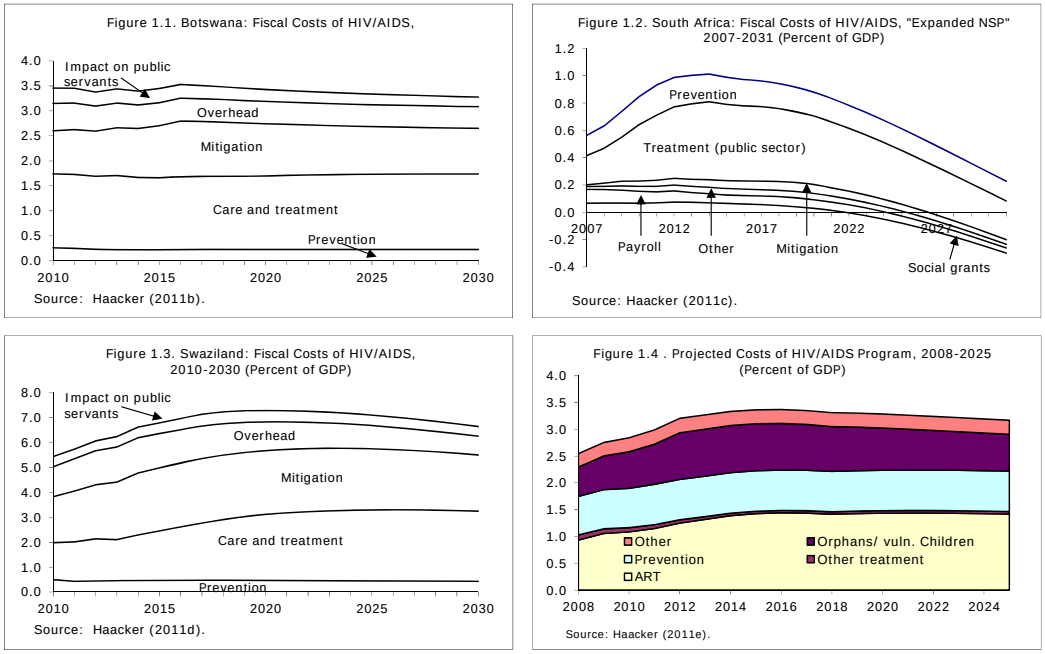
[9]Our estimates of the present discounted value of the HIV/AIDS program or of a single infection are generally based on a 60-year time horizon.

projected costs of HIV/AIDS programs and of the costs over incurred by single HIV infections that our analysis builds on.

VI. Findings

As a starting point, Figure 1 summarizes the **projected fiscal costs of HIV/AIDS** for Botswana, South Africa, Swaziland, and Uganda. The projected costs are highest in Swaziland, growing to over 6 percent of GDP, driven primarily by increasing costs of treatment, high costs of mitigation (mainly orphan support), and high overhead expenses. One reason why the costs of HIV/AIDS in Swaziland come out much higher than in Botswana (which has about the same level of HIV prevalence) is the fact that the level of GDP per capita in Swaziland (US$ 3,100 in 2010) is much lower than in Botswana (US$ 6,800 in 2010, according to IMF (2010), whereas some of the costs are similar across countries.

Figure 1. Fiscal Costs of HIV/AIDS in Four Countries



The comparison between Botswana and Uganda accentuates our earlier point that economic capacities are as important a determinant of the challenges of financing the costs of HIV/AIDS as is HIV prevalence. While HIV prevalence in Uganda (6.4 percent in 2009, according to UNAIDS (2010) is only about one-fourth of the level of HIV prevalence in Botswana (24.9 percent in 2009), the level of GDP per capita in Uganda (US$ 500 in 2010) is equivalent to only 7 percent of the level of GDP per capita. Indeed, our comparison understates the burden faced by the Government of Uganda (compared to the burden in Botswana), as our estimates are based on the respective national HIV/AIDS programs (i.e., the actual or targeted supply of HIV/AIDS-related services). However, access to HIV/AIDS-related services in Botswana is higher than in

Uganda, attaining the same coverage of services in Uganda would result in higher costs relative to GDP.

Finally, the estimates for South Africa differ substantially from those for the other three countries. While the costs of the HIV/AIDS program increase to about one percent of GDP by 2017 and slowly taper off subsequently, the impact of HIV/AIDS also has implications for the costs of social grants. This primarily reflects the impact of HIV/AIDS on the population pyramid and its implications for the fiscal costs of old-age grants, which – according to our estimates – would increase from 1.3 percent of GDP to 1.8 percent of GDP without the impact of HIV/AIDS, but remain at 1.4 percent of GDP instead.

As much of the fiscal costs of HIV/AIDS are financed by external support, a note on the **role of external financing** is in order. We interpret the commitments under the HIV/AIDS program primarily as a fiscal liability, i.e., the national government in the first place is accountable to its citizens for delivering health services and meeting the demand for other HIV/AIDS-related needs. This device also enables much of the analysis presented here, as our analysis implies that the fiscal costs of HIV/AIDS over time can be analyzed in an integrated fashion, irrespectively of the financing of the various components of the HIV/AIDS program

However, in many countries the national response to HIV/AIDS is enabled by substantial external support. A discussion of whether an ambitious HIV/AIDS program primarily reflects the national government's policy objectives, and external support responds to the large fiscal shock experienced by countries facing a large burden of HIV/AIDS, or whether the targets under the HIV/AIDS program reflect donor preferences and – to the government – reduced relative prices of HIV/AIDS-related services (owing to anticipated collateral financing by donors) is beyond the scope of our analysis.

If one accepts that, in the first place, the government is accountable to its citizens for maintaining the quality of public services, we can analyze to what extent public finance is vulnerable to changes in the availability of external support. To make this point, we use Uganda as an example, where external financing under the current National Strategic Plan (Uganda AIDS Commission (2007) was assumed to account for 85 percent of the total costs of the HIV/AIDS program. This level of support would contain the fiscal costs of HIV/AIDS at about 0.5 percent of GDP, and the quasi-fiscal liability implied by the costs of the HIV/AIDS program at 27 percent of GDP (15 percent of 182 percent of GDP).

However, this would require that external financing would have to rise from around US$ 0.3 billion programmed for 2010 to US$ 1.5 billion in 2030, growing at an average annual rate of 8 percent. As this rate of growth is much higher than GDP growth for advanced economies, HIV/AIDS-related aid to Uganda would need to rise relative to available aid budgets. To illustrate the vulnerability of Uganda's public finance (or of the objectives of the HIV/AIDS program) to a slowdown in the rate of external financing, assume that external financing in support of the HIV/AIDS program will rise by only 2.5 percent annually, in line with GDP growth

in the main donor countries.[10] In this case, the available external financing would rise to "only" about US$ 0.5 billion by 2030 (at constant prices). Consequently, domestic financing would need to increase steeply, rising to 2 percent of GDP by 2020, equivalent to 12.5 percent of total government revenues, and remain at about that level through 2030.

The **present discounted value of the spending commitments caused by HIV/AIDS or implied by the HIV/AIDS program** represents the amount that would need to be put aside now to cover the anticipated fiscal costs of HIV/AIDS indefinitely (after discounting future costs with the applicable interest rate). It therefore is a useful summary measure that captures not only the level of current spending at any point in time, but also the fact that the costs of addressing the demand for HIV/AIDS-related services are highly persistent. For policy design, it also provides a crude measure to compare the fiscal implications of alternative HIV/AIDS interventions. A statement that "investments in HIV prevention programmes are insufficient and should increase" (UNAIDS (2010, p. 85)), while "at a time of financial constraint, good investments are more important than ever" (UNAIDS (2010, p. 7)), in this framework, would mean that increased prevention spending (or an improved allocation across prevention measures) now results in a lower number of infections, reduced future demand for HIV/AIDS-related services and HIV/AIDS-related spending, and thus reduces the fiscal burden of HIV/AIDS as measured by the present discounted value of spending commitments under the HIV/AIDS program. Similarly, Haacker (2011c) points out that the fiscal costs of the more comprehensive "Expanded NSP" program in South Africa are about the same as the "Narrow NSP" program, reflecting higher coverage rates of services, but also reduced HIV incidence under the "Expanded NSP" program.

Table 3. Present Discounted Value of Fiscal Costs of HIV/AIDS, 4 Countries

	Costs Incurred by Infections through 2010	Total Projected Costs
	(Percent of GDP)	
Botswana	94	192
South Africa		
HIV/AIDS Program	27	37
Overall Fiscal Costs	9	17
Swaziland	151	293
Uganda (discount rate: 3 percent)	182	372
Uganda (discount rate: 5 percent)	109	206

Source: Haacker (2011a, 2011c). If not stated otherwise, the present discounted value is based on a discount rate of 3 percent.

Table 3 summarizes the estimates of the present discounted value of HIV/AIDS for Botswana, South Africa, Swaziland, and Uganda. For Botswana, Swaziland, and Uganda, the quasi-liability implied by the costs of meeting the demand for HIV/AIDS-related services for people already living with HIV/AIDS (as of 2010) is very substantial, at about the level of annual GDP or higher. A level of debt of this order of magnitude would raise questions regarding the

[10] This is similar to the average real GDP growth rate of 2.4 percent annually for the G7 economies for 2012-2015 assumed by IMF (2010).

sustainability of the fiscal position or macroeconomic stability.[11]In Uganda, the present discounted value of the costs of HIV/AIDS is much higher than for Botswana, even though the costs relative to GDP presented in Fig. 1 are similar, reflecting that GDP growth in Uganda is much higher, and the fairly stable profile of the fiscal costs of HIV/AIDS relative to GDP in Uganda mask a steep increase in absolute terms.[12]The estimates for South Africa stand out because of the large role of social grants (partly offsetting the fiscal costs of HIV/AIDS), and because the fiscal costs of new infections (the difference between the total costs and the costs incurred by HIV infections through 2010) is relatively low. This reflects that the "expanded NSP" scenario we draw on envisages an aggressive HIV prevention program.

If estimates for the projected numbers of new HIV infections are included in the estimates, the present discounted value of the fiscal costs of HIV/AIDS roughly doubles for these three countries. Future infections, however, are also an outcome of the government's HIV/AIDS policy. Indeed, our estimates of the fiscal costs including the projected future infections yield a yardstick for assessing the cost-effectiveness of investments in prevention.[13] Using Botswana as an example, the present discounted value of the costs incurred by projected HIV infections is 98 percent of GDP. A prevention program that reduces HIV incidence by 10 percent would therefore result in savings equivalent to 9.8 percent of GDP. The net impact on fiscal space of this hypothetical prevention program then depends on the costs of the program. Provided that the annual costs are below 0.294 percent of 2010 GDP,[14] or US$37 million annually (at 2010 prices), the additional expenditures under this program would actually reduce the fiscal costs of HIV/AIDS. Alternatively, suppose the costs of this proposed prevention program were US$50 million annually. Then the *net* fiscal costs were equivalent to US$13 million on average (US$ 50 million minus US$ 37 million, with higher costs initially offset by the resulting savings as the demand for HIV/AIDS-related services is reduced later on.

According to our interpretation of HIV/AIDS as a fiscal quasi-liability, arising from spending commitments under the national HIV/AIDS program in response to the demand for HIV/AIDS-

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[11]For example, Reinhart and Rogoff (2010) find that annual growth declines by about two percent when external debt reaches 60 percent of GDP in emerging markets. This link may reflect different factors (quality of public policy, country risk perceptions, resulting compression of fiscal space), not all of which translate well into our analysis of HIV/AIDS as a fiscal (quasi-)liability. However, the comparison serves to underline the point that the fiscal commitments implied by the HIV/AIDS programs are large from a macroeconomic or fiscal perspective.

[12] Further, the estimates of the present discounted value for Uganda – evaluated at a discount rate of 5 percent – offer an opportunity to place the fiscal costs of HIV/AIDS against the backdrop of the debt sustainability analysis conducted by IMF and World Bank (2010). The fiscal costs of HIV/AIDS correspond to 9 times the level of public debt, and are about 7 times as large as the debt relief received by Uganda through the HIPC Initiative and MDRI.

[13]Note that we are using a very narrow concept of cost-effectiveness, focusing only on the implications on the fiscal balance. We do not propose to use this criterion as a sole indicator for policy choices.

[14] At a discount rate of 3 percent, a present discounted value of 9.8 percent of 2010 GDP is equivalent to a permanent flow of 0.294 percent of 2010 GDP (= 3 percentof 9.8 percent of 2010 GDP).

related services, the fiscal costs of HIV/AIDS are ultimately incurred by HIV infections. To illustrate the link between HIV incidence and the fiscal costs of HIV/AIDS, we present **estimates of the expected fiscal costs over time, and the resulting fiscal quasi-liability, incurred by a single infection.** These estimates provide an important building block for the analysis of the evolving fiscal burden of HIV/AIDS on the macroeconomic level, they also are useful to assess the cost-effectiveness of prevention measures on the microeconomic level.

Figure 2. Fiscal Costs Incurred by Single HIV Infection in Four Countries, 2010

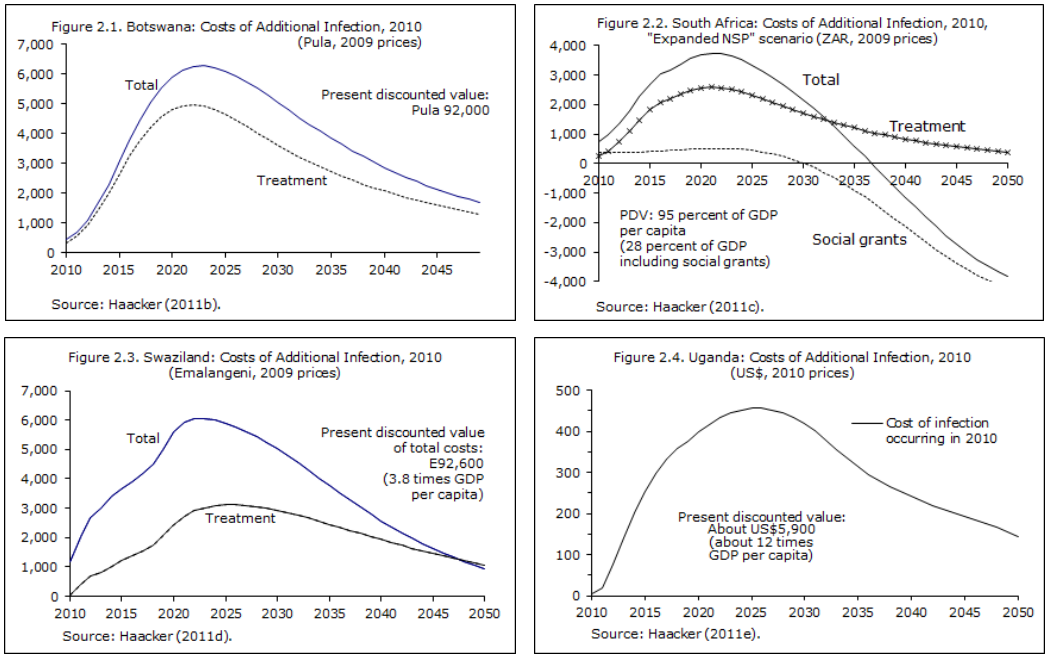


Figure 2 summarizes our estimates. The expected costs incurred by a single HIV infection rise for the first 15 years following an infection, largely reflecting the evolving costs of treatment.[15] After about 15 years, the costs of treatment (and the expected costs overall) decline, primarily owing to increased mortality (although an increasing share of long-term survivors would receive more expensive types of treatment. In absolute terms, the costs incurred by a single infection range from about US$ 12,000 for Botswana and Swaziland, to US$ 7,000 for South Africa, to US$ 6,000 for Botswana. Relative to economic capacities (e.g., GDP per capita), however, the differences are much larger – the costs incurred by one HIV infection are equivalent to 95 percent of GDP per capita in South Africa (excluding the impacts on social grants), 1.8 times GDP per capita in Botswana, 3.8 time GDP per capita in Swaziland, and about 12 times GDP per capita in Uganda.

Our analysis started out from the observations observation that (1) HIV/AIDS programs imply fiscal commitments which extend over long periods of time, and (2) that most of the fiscal

[15]Recall from our discussion of the underlying methodology that the expected costs are calculated based on the probability of being in a particular state (e.g., “treatment need”) at a point in time, multiplied by the coverage rate of applicable services, and the unit costs of the relevant services.

costs are ultimately caused by HIV infections. We developed these two observations estimating the (present discounted) value of the quasi-liability implied by the commitments under the HIV/AIDS program, and estimating the fiscal commitments which are incurred as a consequence of an additional HIV infection (as explained in the "microeconomic" part of our methodology section).

As explained in the "macroeconomic" part of the methodology section, we merge these different strands of thought, describing the costs of the HIV/AIDS program as an evolving fiscal liability, with new liabilities being incurred as a consequence of new HIV infections, and "paid off" as the HIV/AIDS-related services are delivered. On the microeconomic level, the quasi-liability is the expected value of the HIV/AIDS-related services that a person newly infected by HIV could expect. As these services are delivered, the remaining expected value of services declines as the disease progresses, and, following the death (and after all surviving dependents have grown out of social mitigation services), the fiscal quasi-liability of the additional infection has been fully paid off and its remaining value is zero.

Our macroeconomic analysis builds on the evolving costs of a single infection over time (which changes over as targeted coverage rates of services or unit costs change), and estimates the costs incurred by new infections by multiplying the number of new infections with the costs incurred by a single new HIV infection. Conversely, as the anticipated HIV/AIDS-related services are delivered, the fiscal quasi-liability is paid off. As we are focusing on the quasi-liability implied by the fiscal costs of HIV/AIDS relative to GDP (expressing its value in percent of GDP), the other important factor determining the change in the quasi-liability is the rate of GDP growth – a high rate of GDP means that the value of the quasi-liability, relative to GDP, goes down.[16]

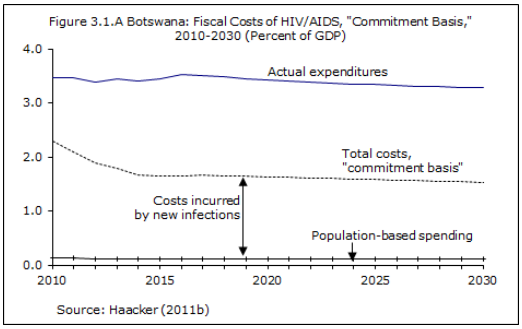
Figure 3 summarizes our estimates of the evolving fiscal quasi-liability implied by the commitments under the HIV/AIDS program for Botswana, South Africa, Swaziland, and Uganda. With the exception of Botswana, the costs incurred by new infections are somewhat higher than actual spending initially, but decline over the projection period. Only in Swaziland there is a small increase in the costs newly incurred between 2010 and 2014, this reflects an increase in HIV/AIDS-related services programmed over this period.

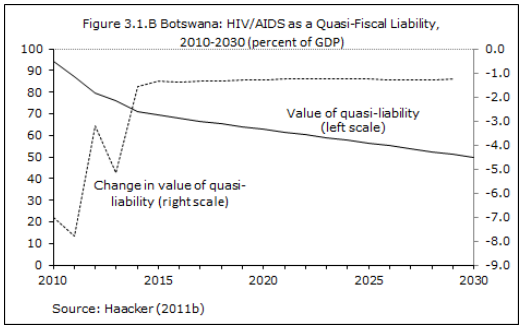
As a consequence of the programmed declines in HIV incidence, and the resulting declines in the costs incurred by new infections, the quasi-liability implied by the fiscal costs of HIV/AIDS declines for all countries. The steepest declines projected to occur in Botswana, where the costs incurred by new infections are only about one-half of current spending, and the value of the quasi-liability drops from 94 percent of GDP in 2010 to 50 percent of GDP by 2030. [Calculations and figure for South Africa (Fig. 3.2.B) still need to be added.] In Swaziland, the decline in the costs incurred by new infections occurs later than in Botswana (where much of it precedes our projections period), and new spending commitments are higher, relative to actual spending. Consequently, the fiscal quasi-liability declines more slowly, from 151 percent of GDP in 2010 to 109 percent of GDP in 2030. In Uganda, the costs incurred by new infections are not much lower

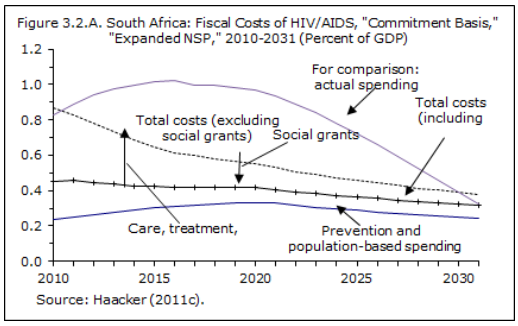
[16]An additional – in our analysis time-invariant – factor is the discount rate used to calculate the value of the quasi-liability and of the commitments incurred by new infections.

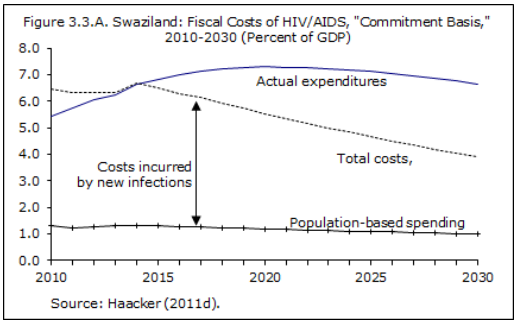
than actual spending. This, however, reflects that population growth and GDP growth are much higher than in the other countries. As a consequence, the number of people living with HIV in Uganda today is close to the peak reached in the mid-1990s (even though HIV prevalence has declined steeply), and high GDP growth rates contribute to the decline in the value of the fiscal quasi-liability (in percent of GDP). Overall, the value of the fiscal quasi-liability declines from 109 percent of GDP to 75 percent of GDP.

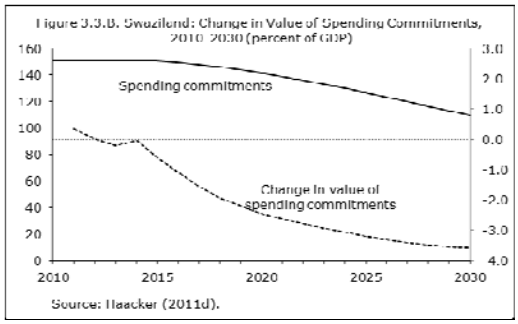
Figure 3. HIV/AIDS as a Fiscal Quasi-Liability in Four Countries

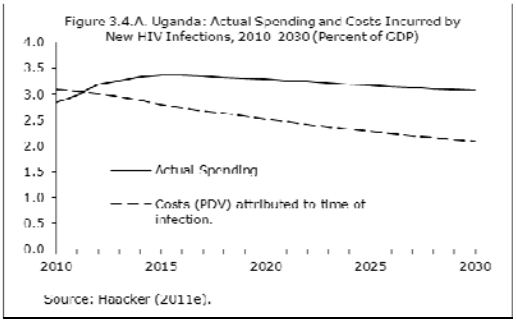


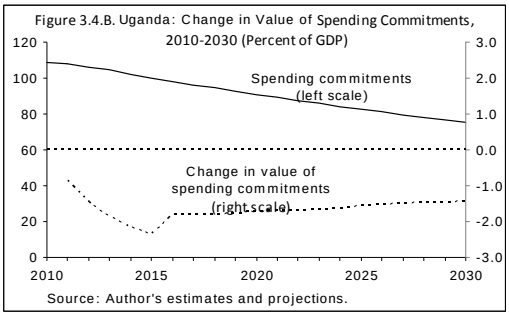












VII. Conclusions

Based on two observations – that most of the fiscal costs of HIV/AIDS are ultimately caused by HIV infections, and that the demand for HIV/AIDS-related services is highly persistent and follows HIV infections with a long lag – we develop tools to analyze the fiscal burden of HIV/AIDS, interpreted as a fiscal quasi-liability, i.e., a spending commitment that extends over a long period and cannot be changed easily ex post (similar, in this regard, to pension commitments).

Drawing data from four recently completed studies discussing the long-run fiscal consequences of HIV/AIDS (covering Botswana, South Africa, Swaziland, and Uganda), we estimate the overall value of future spending commitments in response to HIV/AIDS, the value of the spending commitments made, under the HIV/AIDS program, of a single infection, and provide an analysis of the evolving fiscal burden of HIV/AIDS.

Regarding the overall value of future spending commitments, we find that the fiscal quasi-liability implied by these commitments in these countries is large from a macroeconomic or fiscal perspective (e.g., 27 percent of GDP in South Africa, 94 percent of GDP for Botswana, 151 percent of GDP for Swaziland, and 182 percent of GDP for Uganda). While HIV prevalence obviously is an important determinant of the burden, the largest challenge relative to GDP occurs in Uganda, a low-income country (GDP per capita equivalent to 8 percent of Botswana's GDP per capita) with much lower HIV prevalence compared to the other countries. Interpreted as a kind of debt, the level of HIV/AIDS-related spending commitment raises questions regarding fiscal sustainability. In Uganda, the fiscal quasi-liability owing to HIV/AIDS is several times larger than debt relief received under the HIPC Initiative and MDRI.

Most of the fiscal costs of HIV/AIDS are incurred as a consequence of HIV infection. We estimate that the fiscal resources committed under the HIV/AIDS program as a consequence of an additional HIV infection are equivalent to 95 percent of GDP per capita in South Africa (excluding the impacts on social grants), 1.8 times GDP per capita in Botswana, 3.8 time GDP per capita in Swaziland, and about 12 times GDP per capita in Uganda.

While HIV/AIDS-related spending remains substantial over the projection period, these costs are ultimately caused by new infections, and these are projected to decline (at least relative to the size of the population) in all four countries over the next decades. As a consequence, the value of the fiscal quasi-liability implied by the HIV/AIDS program is declining, from 27 percent of GDP in 2010 to [xxx] percent of GDP in 2030 for South Africa, from 94 percent of GDP to 50 percent of GDP for Botswana, from 151 percent of GDP to 109 percent of GDP for Swaziland, and from 109 percent of GDP to 75 percent of GDP for Uganda

Where does this take us? Most directly, our analysis improves the tools available for analyzing policy choices regarding a country's HIV/AIDS program – on the macroeconomic level, by accurately measuring the level of and changes in the fiscal burden of HIV/AIDS, and on the microeconomic level, by providing a measure of the fiscal costs of additional infections, which could be used (in addition to criteria capturing the immediate health benefits) in assessing the

cost-effectiveness of proposed prevention measures or the effectiveness of the allocation of funds within the HIV/AIDS program across interventions.

More generally, our analysis represents HIV/AIDS and the response to HIV/AIDS as significant factors for assessing the state of public finance, and fiscal planning. This is most directly obvious for the countries where most of the funding of the HIV/AIDS program comes from domestic resources. However, even where the bulk of the financing of the HIV/AIDS program comes from external support, our analysis provides valuable insights, regarding the cost effectiveness of the program, the evolving commitments implied by the HIV/AIDS program, and for defining appropriate roles for domestic financing and external support.

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