POLICY BRIEFS ON

ECONOMIC IMPACT OF HIV

5.

CAPITAL AND INVESTMENT

This brief forms part of a body of work on the Economics of HIV, funded by the Bill & Melinda Gates Foundation (INV-002382). The authors acknowledge the contributions of the participants of the 'Economics of HIV' meeting in Cascais, Portugal, in September 2018 for general direction on this work. The brief was reviewed in-depth by Arjun Vasan from the US Treasury. The brief reflects the authors' views and not necessarily those of the institutions they represent.

Recommended citation:

Markus Haacker, Kate L Harris, Gesine Meyer-Rath: Capital and Investment. Policy brief #5 of series "Economic Impact of HIV". Johannesburg, September 2020.

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CAPITAL AND INVESTMENT

KEY POINTS

- **The direct effects of health-related productivity shocks on economic output are magnified by their negative impact on investment.** Poorer health decreases productivity, which results in lower economic output and consequently lower investment, which again reduces productivity and output over time.
- **Higher mortality reduces incentives for saving and investment.** Empirical studies (not HIV-specific) suggest that this could be an important link between HIV and growth, but there is no clear evidence on such drops in savings and investment in countries facing a large HIV burden.
- **Some HIV-related spending may "crowd out" capital investment which would occur if the funds were used differently.** However, to the extent that spending on the HIV response contains investment, the net effect on investment and capital accumulation is mitigated and could even be reversed.

HIV may affect investment and capital accumulation both directly and indirectly. First, spending on the HIV response replaces spending for other purposes, including investment. Second, lower investment means that less capital is accumulated over time, resulting in lower GDP per capita.

Capital accumulation magnifies impacts of health shocks on growth

Lower productivity caused by a health shock such as HIV results in lower output and consequently lower investment, which again reduces output over time. This effect on investment approximately doubles the direct effects of health-related productivity shocks on output.

In standard neoclassical models of economic growth (e.g., Mankiw, 2018; Jones & Vollrath, 2013),[1] a drop in output due to lower productivity sets off a gradual macroeconomic adjustment characterised by lower investment and a gradual decline in the capital-labour ratio, resulting in a period of lower economic growth until the economy reaches a new equilibrium at a lower level of output. The magnitude of such an indirect effect can be significant. Under common assumptions regarding the shape of the production function in developing countries, the reduced accumulation of capital roughly doubles the overall effect of lower productivity on output (see Annex describing the model used in this brief for calibrating the economic effects of HIV). This adjustment process, however, operates slowly: it typically takes about one decade for half of the adjustment to be completed.

Concretely, this means that a productivity shock that immediately reduces GDP per capita by 1 percent can result in an *additional* loss in GDP per capita of about 0.5 percent after 10 years, and subsequent slower declines until the full effect of 2 percent of GDP per capita is realised.

1 See the Annex to this brief for an illustration of the model.

Through a similar mechanism, the neoclassical models also estimate how investment and capital accumulation modify the macroeconomic effects of increased mortality and changes in population growth. For example, if a health shock results in a loss of 1 percent of the population (setting aside any other disruptions which might be associated with this), GDP declines by between about 0.5 percent and 0.67 percent.[2] GDP per capita increases accordingly by about 0.33-0.5 percent. However, the lower level of GDP is not sufficient to sustain the previous level of capital, and the capital stock declines until GDP drops by 1 percent (the same change as the loss in the population size) and the temporary increase in GDP per capita is nullified.

These two effects – the direct effect of a change in population size and the changes in investment it triggers – are also present when a health shock results in a permanent decline in the rate of population growth. Here the repeated declines in population have a cumulative positive effect on GDP per capita, but these effects are partly offset through lower investment. Following an adjustment period, the economy settles at a new equilibrium. For example, if population growth declines by one percentage point, GDP growth eventually also declines by one percent, but with a level of GDP per capita that is about 5-10 percent higher than otherwise (see Annex).

2 Here and further below, the ranges in economic effects reflect differences in how responsive output is to changes in capital or labour, summarised by the parameter γ in the model described in the Annex. If output responds little to changes in labour, then a loss in the size of the population has little effect on output, and therefore translates into a relatively large effect on output per capita.

Increased mortality results in lower savings

Economic models and empirical evidence suggest that higher adult mortality results in lower savings. In the long run, however, higher mortality changes the age structure of the population, resulting in a more ambiguous link between mortality and the aggregate savings rate. In any case, countries facing high AIDS-related mortality did not experience the large effects on savings predicted by some models.

The savings rate is a key determinant of economic growth and GDP per capita. A higher savings rate results in a higher capital-labour ratio and higher GDP per capita. This link is quantitatively important, as a 10 percent increase in the savings rate would eventually increase GDP per capita by 5-10 percent. This increase in GDP per capita, which works through a gradual increase in the capital-labour ratio, would occur slowly – one-half of the adjustment would take about 10 years.

The potential impact of HIV on savings behaviour is therefore an important aspect of the appraisal of the economic impact of HIV. One important channel through which HIV may affect savings is increased mortality and reduced life expectancy for the working-age population.

Increased life expectancy – specifically, increased remaining life expectancy – creates an incentive to save more, in order to secure one's standard of living in old age. But this increased incentive does not necessarily result in a higher savings rate out of an individual's current income. Individuals could also retire later, especially if longer life expectancy is associated with an improved age-specific state of health (Bloom et al., 2010).

In addition to these individual effects, it is necessary to take into consideration the composition of the population, and specifically the distinction between the working-age population, who are saving for retirement, and the population at later stages of their lives, who are drawing down savings. Population ageing per se thus tends to lower the savings rate, and it is conceivable that the positive effects of improved life expectancy on savings are offset over time as – owing to reduced mortality – an increasing share of the population reaches old age and starts dis-saving (Bloom et al., 2003). Such a demographic adjustment takes decades, however. For the appraisal of the macroeconomic consequences of HIV and of the HIV response, it is therefore sensible to focus on the immediate effects of changes in mortality or life expectancy on the savings rate.

Empirical studies addressing the link between savings and life expectancy or mortality in general, not specifically addressing HIV, suggest that the impact of increased life expectancy on savings is positive and potentially important. Bloom et al. (2003) estimate that one additional year of life expectancy is associated with an increase in the savings rate of about 0.4 percentage points (with some variation across specifications). This is a large effect with regard to the potential economic impacts of HIV. For example, with an underlying savings rate of 15 percent, a loss in life expectancy of 10 years would reduce the savings rate by 4 percentage points, and eventually lower GDP per capita by 13-27 percent. Similarly, Lorentzen et al. (2008) suggest that an increase in adult mortality (ages 15-60) of 0.1 percentage points (i.e. 1 death per 1,000 people per year), compared with a mean of 0.3 percent, would reduce the savings rate by 1.9 percentage points. A sustained increase in HIV-related mortality could therefore have a severe effect on the savings rate. For example, adult mortality at ages 15-60 in Botswana increased by up to 1.3 percentage points because of HIV (as of 2003), which would reduce the savings rate by 25 percentage points – a decline almost as high as the total level of savings. As of 2018, HIV-related mortality in Botswana had declined to 0.25 percent at ages 15-60, which would still result in a decline in savings of 4.75 percentage points, and – if mortality remained at this level –would reduce GDP by about 6-12 percent in the longer run.

Such a steep drop in the savings rate, however, has not happened in Botswana, nor in other countries facing a severe HIV epidemic. One possible explanation is the issue of "out-of-sample projection" – the mortality shocks encountered in countries facing high HIV prevalence are outliers compared to those in the empirical studies discussed above. While the models may work well for typical changes in mortality, the results may not extrapolate well to larger shocks. Second, the effect operates through reduced expected life expectancy. In other words, it requires that individuals be aware of changes in projected mortality and fully factor these into their outlook on life. It is not clear if this requirement has been met because of the stigma attached to HIV and the fact that accessing and appraising relevant information is a slow process. While there is microeconomic evidence that HIV has had some impact on savings behaviour at the household level (Baranov & Kohler, 2018), the macroeconomic data suggest that any such changes in expectations did not have a forceful effect on aggregate outcomes.

HIV-related spending may crowd out investment

Public or private spending on HIV is not available for other purposes, including investment. To the extent that HIV spending "crowds out" investment, it reduces capital accumulation and, gradually, output. However, spending on the HIV response may itself represent investment.

The best-documented impacts of HIV on savings and investment involve households affected by HIV, which experience drops in income when an income earner becomes sick or other household members have to take time off to care for a sick household member, while health-related expenditures crowd out other types of household spending. As a consequence, households affected by HIV frequently sell assets or borrow. (This is discussed in more detail in brief #8, on the economic consequences of HIV across households.) From a macroeconomic perspective, this household response contributes to a decline in the savings rate. However, the magnitude and macroeconomic relevance of these household-level effects is not well established. Some of the negative income effects in households affected by HIV are – from a macroeconomic perspective – offset by gains in other households, e.g., if a sick person loses an employment and a person from a different household gains it. The contributions of households affected by HIV to aggregate private investment (their weights in relation to other private households, and the breakdown in household vs. corporate investment) are also not well understood.

Because of these challenges in assessing the consequences of HIV for investment using a bottom-up approach, building on microeconomic data, most assessments of the link between HIV spending and investment follow a top-down approach, assessing effects on investment based on estimates of the cost of the HIV response (and assumptions about how much of these costs result in low investment). In some countries, the HIV response absorbs a significant amount of resources (Figure 5.1; most data relate to 2017 or 2018). Total (domestic and foreign-financed) HIV spending across all countries covered by UNAIDS (2019) amounts to up to 4 percent of GDP, with the highest level attained in Lesotho, a country with low GDP per capita and very high HIV prevalence (Figure 5.2). In the countries which face the most severe financial burden, however, external financing accounts for a substantial share of the expenditure on the HIV response. For instance, in countries where expenditure on the HIV response exceeds 1 percent of GDP, external financing ranges from about 40 percent of total HIV spending (in Botswana and Namibia) to about 97 percent of total HIV expenditure (in Haiti, Malawi and Mozambique).

Figure 5.1: Total and domestic public HIV spending (percent of GDP, latest year)

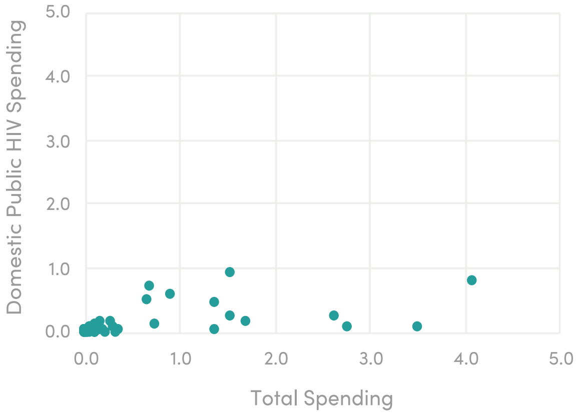
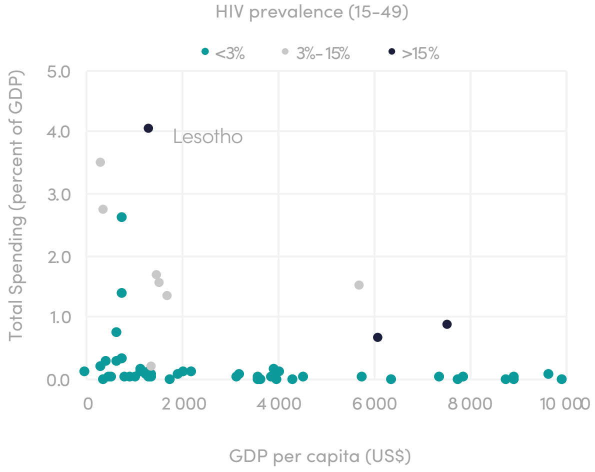


Figure 5.2: Total HIV spending vs. GDP per capita (latest year)



Source: UNAIDS (2019).
Note: Figures cover all countries with a level of GDP per capita lower than US$ 10,000 covered by UNAIDS.

An assessment of the crowding out of public investment by spending on the HIV response thus needs to differentiate between externally financed spending and domestically financed spending. If external financing of the HIV response were to crowd out external financing of other projects, this could have an important impact on public investment which is often partly funded externally. In Malawi, for example, external financing of government development spending (which consists largely of investment) amounted to 3.5 percent of GDP, and over 60 percent of total government development spending. Such crowding out could happen if HIV funding and other development assistance are funded out of a donor's fixed budget for development assistance. It is, however, implausible that external financing of the HIV response crowds out external financing for other purposes in any specific aid-receiving country, because external funding for HIV comes predominantly from HIV-specific funding instruments rather than country-specific allocations of general aid by donors.

Expenditure on domestic financing of HIV exceeds 0.1 percent of GDP in only 12 of the 80 countries for which HIV spending data are available from UNAIDS (2019). On this count, the highest burden tends to fall on middle-income countries with very high HIV prevalence (Botswana, Lesotho, Namibia, South Africa), where domestically financed HIV spending exceeds 0.5 percent of GDP. The consequences of such domestic spending in terms of capital accumulation depend on how much investment is displaced by the expenditure on HIV. For example, in a country where domestic HIV spending is among the highest, where total investment amounts to 20 percent of GDP, HIV spending amounts to 0.5 percent of GDP, investment accounts for 15 percent of domestic government spending, HIV spending displaces government investment and consumption proportionally, and no HIV spending represents an investment, then investment is 0.4 percent lower than otherwise because of HIV spending.[3]

Eventually, through the process of capital accumulation described in the first section, this lower investment would result in a level of GDP per capita which is 0.5-0.8 percent lower than otherwise (using the model described in the annex). This output loss, however, could turn out to be smaller, depending on two factors: first, if domestic HIV spending is more than proportionately or entirely financed from current spending, and second, to the extent that HIV spending also contains investment. (If HIV spending contains more investment than alternative spending, then the impact of HIV spending on investment and capital accumulation could even be positive.) This eventual output loss occurs through a gradual slowdown that is spread over more than a decade (as described in the first section). Relative to annual effect on GDP growth (averaging about 4 percent annually across sub-Saharan Africa in 2009 to 2019), the growth effect is thus very small, even in countries with relatively high levels of domestic HIV spending.

3 The calculation is as follows: reallocation of government spending of 0.5 percent of GDP, 15 percent of this crowds out investment, so investment declines by 0.075 percent of GDP, which is about 0.4 percent of total investment of 20 percent of GDP.

Limitations

Our calibrations on the impacts of HIV on economic growth through investment and capital accumulation do not include two aspects which might play a role. First, owing to data limitations we do not account for investment expenditure in non-health areas (e.g. construction) that is financed by the HIV response. Especially where investment is low otherwise, such HIV-related investment could mitigate and even reverse the adverse macroeconomic effects of a crowding-out of investment in other sectors by HIV spending. Second, we do not distinguish between investment by households, businesses or government. This reflects that the bulk of identified HIV spending occurs through governments, and a broad-brush focus on total or public investment is a good approximation. This macroeconomic perspective misses aspects of the impact of HIV across the economy, such as the impacts of ill health or specifically HIV on affected households (Alam & Mahal, 2014; Murphy et al., 2019), or different effects across sectors.

Summary table: HIV, investment and capital accumulation

Direct impact	Macroeconomic implications	Impact of HIV response
Reduced productivity and human capital (briefs #4 and #6)	A shock to output is augmented through reduced investment and – over time – a reduced capital stock.	The effects of direct impacts in reversing losses in productivity or human capital are similarly augmented through investment and capital accumulation.
Increased mortality and reduced life expectancy	High mortality discourages private saving and investment. Reduced investment erodes capital stock and gradually results in lower GDP per capita.	The response reverses impacts on health, and gradually – following recovery of investment – on capital stock and GDP per capita.
		Domestically financed spending on the HIV response crowds out government spending on other purposes, including investment, potentially leading to a gradual reduction in GDP per capita.

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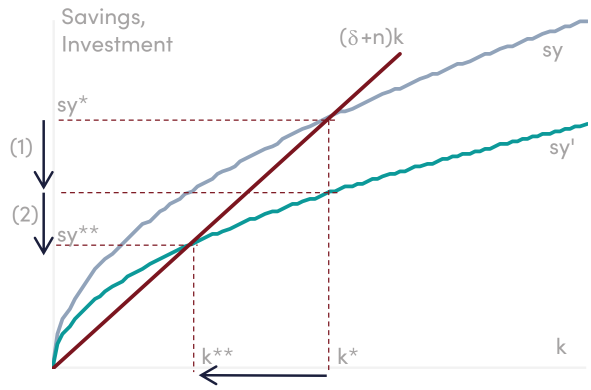
Annex

This annex describes the basic neoclassical growth framework which underlies the discussion on how investment and capital accumulation magnify the direct macroeconomic effects of health-related productivity shocks. The model is discussed in more detail in standard macroeconomics textbooks like Mankiw (2018) or Jones & Vollrath (2013).

In this model, output per capita y depends on the capital-labour ratio k, often expressed as y=f(k) (Figure 5.A1). Each year, the capital-labour ratio is augmented by new investment, but depleted by capital depreciation (at an annual rate δ) and population growth n (the latter because the capital stock is spread over a larger number of workers).

Figure 5.A.1: Output per capita and the capital-labour ratio

Figure 5.A.2: Consequences of a productivity shock



Notes: In Figure 5.A.2, (1) represents the immediate adjustment to lower output per capita (y) and thus savings (sy) following a productivity shock, while the capital-labour ratio (k) is unchanged at that moment. (2) Because investment is lower than what would be required to compensate for depreciation and to accommodate population growth, the capital-labour ratio starts declining at that point, and the economy gradually adjusts to a lower level of output per capita that can be sustained by a lower capital-labour ratio.

This economy attains an equilibrium (with capital labour ratio at k* in Figure 5.A2) in which the amount saved and invested (*sy*, where s is the savings rate) annually is just equal to the losses from depreciation and population growth:

$$sy^*=(\delta+n)k^* \quad (1)$$

If output declines owing to a productivity shock, then *y* and consequently *sy* decline, and ongoing investment is no longer sufficient to offset the annual losses in the capital-labour ratio from depreciation and population growth. This is the beginning of a process through which the capital-labour ratio shrinks until the economy eventually reaches a new equilibrium, at k**.

To quantify this effect, a more concrete specification of the link between y and k is needed. One common form is

$$y=Ak^{\gamma} \quad (2)$$

Using this specification, the equilibrium capital stock (from Eq. 1) can be expressed as

$$k^*=(sA/(\delta+n))^{(1/(1-\gamma))} \quad (3)$$

and

$$y^*=A^{(1/(1-\gamma))}(s/(\delta+n))^{(\gamma/(1-\gamma))} \quad (4)$$

This implies that a productivity shock (a decline in A) by 1 percent reduces output immediately by 1 percent (following Eq. 2), but – when the impact on the capital-labour ratio is taken into account – causes a decline in output by $1/(1-\gamma)$ percent in the longer run, which exceeds the immediate impact by $\gamma/(1-\gamma)$ percentage points.

With typical estimates of the parameter γ in developing countries at about one-third to one-half (Feenstra et al., 2015), the long-term impacts of a productivity shock on output per capita are thus 1.5 to 2 times higher than the immediate effects.

The impacts of a change in population growth on output per capita are obtained by taking the derivative of y* with respect to the population growth rate *n*, i.e.,

$$dy^*/dn=(-\gamma/(1-\gamma))y^*/(\delta+n) \quad (5)$$

For common estimates of n (see above), a depreciation rate of 8 percent, and evaluated at a rate of population growth of 2 percent, this implies that a permanent 1 percent decline in population growth increases GDP per capita by between 5 percent and 10 percent.