INTERNATIONAL MONETARY FUND

Military Spending and Crowding-Out Effects:

Evidence from Sub-Saharan Africa

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WP/26/69

2026
APR

WORKING PAPER

 WP/26/69

IMF Working Paper
African Department

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Authorized for distribution by Amadou Sy
April 2026

ABSTRACT

This paper quantifies the effects of increases in military expenditures on education and health spending using local projections and different strategies to identify exogenous changes in military spending based on data for 33 sub-Saharan African (SSA) economies over the period 1990-2023. Specifications with shocks identified through military spending surges and through a fiscal reaction function yield mixed results that typically are neither economically nor statistically significant. But instrumental variables estimates that tackle endogeneity concerns indicate that a one-standard-deviation increase in the share of military spending in total government expenditure reduces the shares of education and health spending by about 1 percentage point over the medium-term. The crowding-out effects tend to materialize sooner for health expenditures, likely because they have a larger discretionary component, while education spending is marked by rigidities. In addition, we find that military spending shocks tend to crowd-out health expenditures when access to international aid is limited, while there is no evidence of crowding-out when aid is relatively amply available. In contrast, it appears that overall debt levels and the state of the business cycle are not significant factors in determining the extent of crowding-out effects of military expenditure.

JEL Classification Numbers:	E6, H6, O11
Keywords:	Military Spending; Crowding-Out; Social Spending; Sub-Saharan Africa
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* We are grateful to Tohid Atashbar, Felipe Camêlo, Ignatius De Bidegain, Farayi Gwenhamo, Roland Kpodar, Andrea Presbitero, Nikola Spatafora and participants at the IMF's African Department seminar for excellent comments and suggestions. All the usual caveats apply.

WORKING PAPERS

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Evidence from Sub-Saharan Africa

Antonio C. David, Elisee Miningou, Rasmane Ouedraogo, Makoto Tanaka, Alex Vaval Pierre-Charles [1]

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Contents

1. Introduction

Violent conflict events in sub-Saharan Africa increased significantly over the past two decades, with the average quarterly number of incidents in 2024 being five times higher than in 2000.[1] The number of fatalities resulting from these incidents almost tippled over the period. In 2024, violent conflicts claimed more than 50 thousand lives in the region. According to the Institute for Economics and Peace, countries in the Sahel region are the most impacted with a worsening humanitarian crisis, hosting over 5.5 million refugees and internally displaced persons.

Escalating security threats have reshaped fiscal priorities across Sub-Saharan Africa, leading to increases in defense spending. Military spending has risen sharply in many sub-Saharan African countries over the past decade, driven by the worsening security conditions. In the Sahel, for example, defense spending nearly doubled from 2.7 percent of GDP in 2016 to 4.6 percent in 2023. At the same time, insecurity has disrupted economic activity, weakened revenue mobilization and increased demand for development and humanitarian spending. These combined pressures force governments to make difficult allocation decisions within tight fiscal space, balancing urgent security needs against long-term development investment. Understanding the interplay between military and social spending is critical for designing policies that safeguard fiscal sustainability, security and development outcomes.

Some empirical studies suggest that military spending crowds out social spending, consistent with the "guns versus butter" theory, where higher military spending reduces fiscal space for investment in physical and human capital. For instance, Fan, Liu, and Coyte (2018) find a negative link between military and health spending across nearly 200 countries over the period 2000–2013 using seemingly unrelated regressions and simultaneous equation estimation of the determinants of the different types of government expenditures (without considering dynamic effects).

Nonetheless, higher military spending may also lower violence, protect infrastructure, enable service delivery, and reduce overall economic uncertainty associated with high levels of insecurity, thus boosting productivity and GDP growth, with positive spillovers on the quality of public services and technological innovation (Kollias and Paleologou, 2011; Harris, Kelly, and Pranowo, 1988). Using dynamic panel GMM regressions with internal instruments (i.e. lagged values of the endogenous variables), Lin et al. (2015), for example, find a positive link between military spending and government expenditure on education and health using data from 29 OECD countries from 1988 to 2005. Njifen and Aneman (2023) also use dynamic panel GMM regressions for SSA countries and find that military spending slightly increases education spending on average as governments often try to maintain education access in times of security crisis, perhaps due to political pressure.

Another strand in the literature suggests that there is no link between military spending and development spending. Some papers argue that military and social spending each respond to different drivers, such as geopolitical threats and political priorities rather than a strict zero-sum trade-off. For example, Russett (1982) finds that in the United States during the Cold War, increases in defense spending did not significantly reduce education or health budgets, as overall government expenditure expanded to accommodate both priorities. Similarly, Davis and Chan (1990) show that in several OECD countries, periods of heightened military spending were often accompanied by stable or rising social expenditures, financed through borrowing and revenue adjustments rather than direct cuts. Schiff, Gupta and Clements (1998) find that over the period 1985-1992 increases in military spending have tended to come in the context of higher non-military and total spending, as well as sharp increases in the fiscal deficit.

More recently, Marzian and Trebesch (2025) systematically analyze military spending booms driven by exogenous geopolitical shocks rather than domestic factors using disaggregated data on government finances for 20 countries from 1870 to 2022. They do not find significant evidence that social spending is

[1] According to data from the Armed Conflict Location & Event Data Project (ACLED).

cut during military expansions. IMF (2026) also analyzes military spending booms in a broader dataset for 165 countries since 1946 and find on average there are no significant effects on social spending, but when only wartime episodes are considered, social spending (i.e. spending on health, education and social protection) declines in real terms.

Recent studies focusing on Sub-Saharan Africa also reveal mixed evidence on the relationship between military and social spending. Njifena and Anemann (2023) show that despite the average absence of crowding-out effects described above, the data shows that in security-challenged areas such as the Sahel and the Lake Chad Basin rising defense spending crowds out education spending, as governments reallocate scarce fiscal resources to address escalating violence and terrorism. Moreover, evidence from Central and Southern Africa points to instances of complementarity, where defense spending correlates positively with education investment. Countries with stronger governance frameworks tend to leverage security spending to boost growth, thus widening fiscal space (Elshafei et al. 2025).

This paper aims to investigate the relationship between military and social spending in Sub-Saharan Africa, focusing on whether military expenditures exert crowding-out effects on education and health budgets. The paper examines the dynamic fiscal response to military spending shocks using different identification strategies and local projections. It offers a nuanced, policy-relevant analysis of fiscal trade-offs under defense spending shocks, helping inform policies that safeguard social spending while addressing rising security needs.

The contribution of this paper to existing literature is twofold. First, it provides new insights into the conditions under which military expenditures may either constrain or complement social spending by employing multiple identification strategies to isolate the effects of military spending from confounding factors. Specifically, we implement three approaches to identify exogenous changes in military spending: (i) constructing a military spending surge variable based on observed spending patterns (ii) using the residuals from the estimation of a government reaction function in the spirit of Caldara and Kamps (2017), and the preferred approach (iii) using instrumental variables. Secondly, this study examines how state-dependent factors shape the relationship between military and social spending in Sub-Saharan Africa. In particular, we assess whether sovereign debt levels, the availability of official development assistance (ODA), and the business cycle influence the extent to which military spending crowds out social spending. By exploring these state dependencies, the paper provides a more nuanced understanding of the fiscal trade-offs under security shocks.

The remainder of the paper is organized as follows: section 2 presents the data used in the analysis and stylized facts regarding military, health, and education spending in SSA over the sample period. The subsequent section presents the empirical strategy and baseline results. Section 4 assesses the robustness of results by performing a number of checks, including alternative definition of key variables and testing differences in Fragile and Conflict-Affected States (FCS) and non-FCS. Section 5 discusses state-dependencies that may affect the link between military spending and social spending, including the level of debt, the availability of international aid and the state of the business cycle.

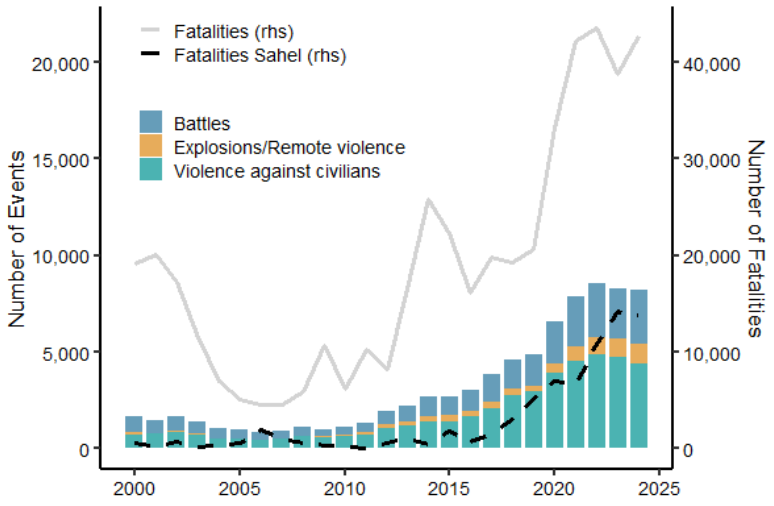
2.Data and Stylized Facts

Context

After a period of relative stability and limited armed conflict from 2000 to 2005, Sub-Saharan Africa experienced a rapid deterioration of its security environment. The collapse of the regime in Libya is often cited as a catalytic event in regional instability as the power vacuum led to a proliferation of armed groups in the Sahel and across SSA, through increased flow of arms and fighters (Strazzari, 2014). This deterioration has unfolded in a setting where violence can spill across borders through multiple channels, including refugee flows, transnational armed networks, illicit trafficking routes, and cross-border ethnic linkages, implying that localized shocks can generate wider regional externalities (Salehyan and Gleditsch 2006; Gleditsch 2007; Abdel-Latif et al. 2025).

Political instability has also intensified. Since 2010 there have been 32 coup attempts in sub-Saharan Africa, with over half being successful.[2] Over the same period, the incidence of violent events such as battles, explosions and violence against civilians increased six-fold between 2010 and 2024, with fatalities rising in parallel (Figure 1). The Sahel countries[3] especially have seen a significant rise in violent events, Burkina Faso, Mali, Niger have consistently ranked among the countries most affected by terrorism worldwide (IEP 2025). In 2024 the Sahel accounted for 23 percent of violent events in Sub-Saharan Africa and 32 percent of fatalities while accounting for only 7 percent of the population.

Figure 1. Evolution of Security Situation in SSA, 2000 – 2024



Source: ACLED

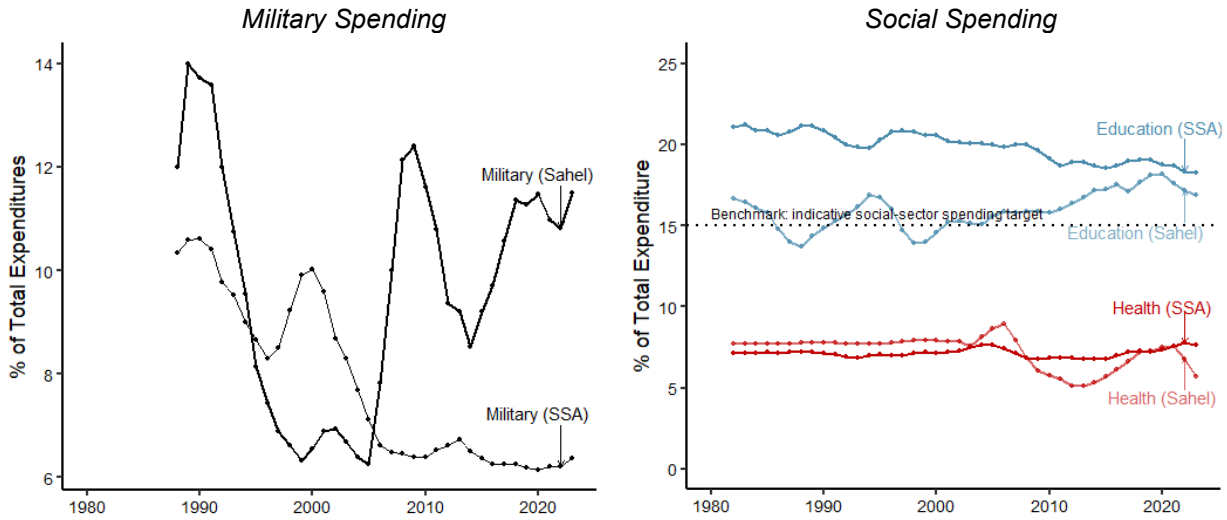
Worsening security conditions create strong political incentives to expand military and internal security outlays , but the spending response has differed sharply across sub-regions. For Sub-Saharan Africa as a whole, military spending as a share of total expenditure has trended downward since 1990, declining steadily after 2000 and stabilizing after 2015, falling from 12 percent of total expenditure to close to 7 percent in 2023 (Figure 2). This overall pattern masks the opposite dynamic in Sahel countries where a significant share of violent events occurs. Military spending has risen markedly between 2005 and 2010

[2] Powell & Thyne (2011).

[3] In this paper we refer to the Sahel as Burkina Faso, Mali, Chad and Niger.

and has been on an upward trend since 2014 to account for about 13 percent of total expenditure, compared to 8 percent in 2014.
These pressures operate in a setting where fiscal space is already constrained. Borrowing costs have risen markedly as interest payments have increased in the last decade for SSA countries. In this context, crowding-out may occur not only because military spending rises, but also because education and health spending may be the components of the budget more easily adjusted at the margin. Moreover, social spending can be more fungible at the margin because these are sectors that are partially donor-financed, creating scope for government to use external resources to finance domestic spending.

Figure 2. Military and Social Spending in SSA



Sources: SIPRI, Gethin (2024).
Notes: The benchmark for social spending is based on the recommendations from UNESCO and the Abuja health goals. We use the 3 year – rolling average share for military and social spending to smooth the lines.

Nevertheless, education and health spending in Sub-Saharan Africa often fall short of international benchmarks. On education, the United Nations Educational, Scientific and Cultural Organization (UNESCO) benchmarks of 4–6 percent of GDP or 15–20 percent of public expenditure is frequently unmet, and per-child public education spending in Sub-Saharan Africa remains far below other regions (UNESCO, 2025). Since 1980, the average share of education spending has been steadily decreasing, falling from around 21 percent of total expenditure in 1980 to below 18 percent in 2023. On health, the Abuja Declaration set an aspirational target of allocating at least 15 percent of national budgets to health, yet since 1980, health spending as a share of total expenditure has remained stable in Sub-Saharan African at around 7 percent.

Data Description

This study draws on several data sources. Military expenditure and ammunition imports are taken from the Stockholm International Peace Research Institute's (SIPRI) Military Expenditure Database. It provides annual data on military spending going as far back as 1949 by using official data provided by national governments as well as alternative sources quoting official data. Estimates of government spending on education and health come from Gethin (2024)'s database of General Government Revenue and Expenditure by Function from 1980-2022[4], which aggregates data from various sources[5] to estimate the composition of public spending with a focus on social sending (education, healthcare and social

[4] It has been updated and contains data until 2023.

[5] These sources include: IMF, Eurostat, OECD, CEPAL, IFPRI, UNESCO, WHO, ADB, CEPAL and the WBG.

protection). Macroeconomic variables come from the International Monetary Fund's World Economic Outlook (WEO) database (October 2025 vintage), which we complement with the Global Macroeconomic Database (GMD) of Müller, Xu, Lehbib, and Chen (2025) to fill gaps, particularly in the earlier years of the sample. Additional macroeconomic variables (e.g., terms of trade, Official development assistance) are taken from the World Bank's World Development Indicators (WDI) database. Data on the VIX volatility index came from Bloomberg and on the 10-year US treasury yields were obtained from Haver. Finally, we use the Armed Conflict Location and Event Data (ACLED) project for the number of fatalities. The data are derived from various sources spanning from local to international sources across different categories such as traditional media to state and international actors.

We exclude 12 SSA countries[6] from our sample due to extremely low military expenditures and generally incomplete or insufficient data. As a result, the final dataset is an unbalanced panel covering the period 1990-2023 and 33 countries.

3. Empirical Strategy and Results

We use the local projection method (Jordà, 2005) to estimate the dynamic effects of military spending shocks on public expenditure on education and health using panel data for 33 sub-Saharan African economies over the period 1990-2023.[7] We specify the baseline regression as follows:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i^h + \beta^h shock_t + \delta X_{i,t} + \Theta_t^h + \varepsilon_{i,t+h} \quad (1)$$

where $y_{i,t+h}$ is a scalar outcome of interest (the share of government spending on education and the share of government spending on health relative to total government expenditure in baseline regressions).[8] α_i^h refers to country fixed effects that help to absorb the effects of certain country characteristics that do not change over time and Θ_t^h refers to global financial variables, namely the VIX volatility index, and the 10-year US treasury yield that capture common shocks across the countries in our sample for a given year. $shock$ is the shock to military spending (which will be defined in different manners below). $X_{i,t}$ is a vector of controls, which include two lags of the dependent variable and the military shocks, the contemporaneous value and two lags of: i) the output gap (obtained using the HP filter), ii) the ratio of aid to GDP, iii) the cyclical component of the terms of trade (using the HP filter); iv) the number of fatalities linked to conflict events per capita; and two lags of the level of government debt as a share of GDP. Variable definitions and sources are discussed in the Annex. $\varepsilon_{i,t+h}$ is the error term. The main coefficient of interest is β^h, which captures the effects of military spending shocks at different horizons. Montiel-Olea et al. (2025) show that the local projection specification of this form is tightly connected to the recursive identification in structural vector autoregression (SVAR) models.

Military Spending and Social Spending

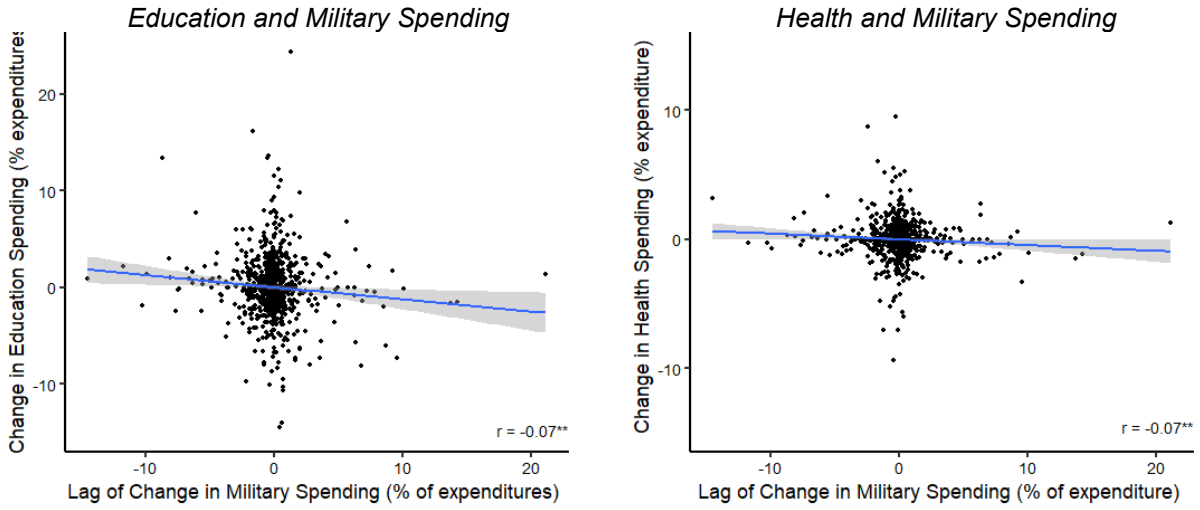
To provide a first non-causal look at whether higher military spending crowds out social spending, we plot changes in health and education spending (as a share of total expenditures) against the lagged change in military spending (Figure 3). The fitted line suggests negative relationship, on average increases in military spending share are followed by small declines in the health and education shares. The association is statistically significant, but the magnitude is modest with a correlation coefficient of about 0.07 which implies that about 0.5 percent of the variation in changes in social spending is explained by co-movements with changes in military share.

[6] These countries are Cabo Verde, Equatorial Guinea, Eritrea, Eswatini, Lesotho, Seychelles, South Sudan, Zimbabwe, Republic of Congo, The Gambia, and Comoros.

[7] Country coverage was constrained by data availability over a sufficiently large time period.

[8] We also perform robustness checks with specifications in which these variables are defined differently, as discussed in subsequent sections. We consider for example government education spending per school age child and government spending on health per capita (both expressed in dollar terms).

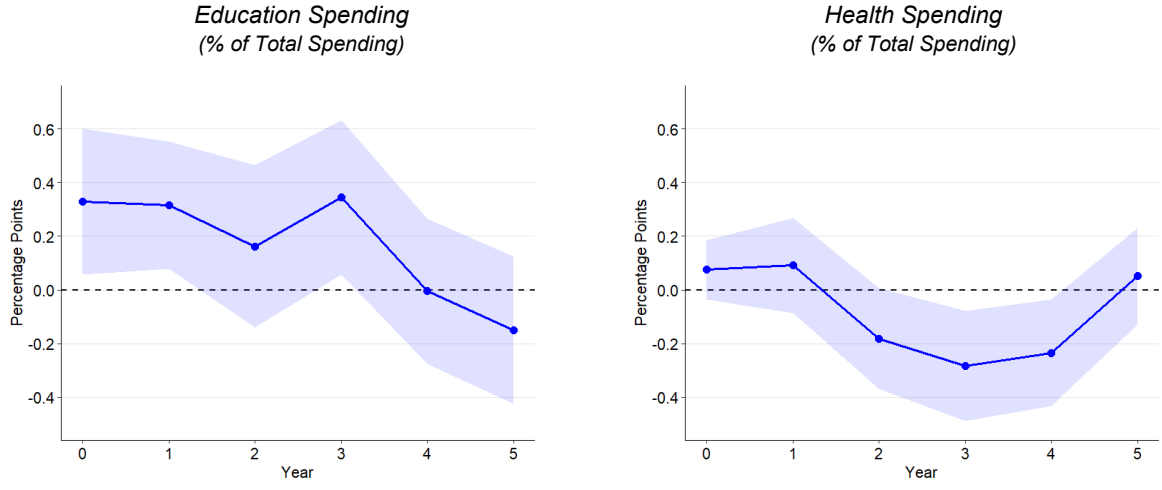
Figure 3. Correlation between Military and Social Spending in SSA



The Effects of Surges in Military Spending

Firstly, we focus on exceptional increases in military spending ("surges"). As described in Section 2, military spending has increased significantly in recent years, particularly in the Sahel region. Our definition of military spending surges derives from the literature on capital flows. We follow Ghosh et al. (2014) and define military spending surges as exceptionally large military spending increases that are in the top 30th percentile of both the country-specific and of the full sample's distribution of military spending. We then define a binary variable that takes the value of 1 if there is a military spending surge and 0 otherwise. The results reported in Figure 4a show that a surge in military spending crowds-out health spending between the years 2 and 4, with the effects being insignificant afterwards. We find that a surge in the share of military spending is associated with a decline in the share of health spending by up to 0.3 percentage points. Regarding education spending, we find that there is an initial crowding-in effect of military spending surges that is small and not statistically significant two years after the shock.

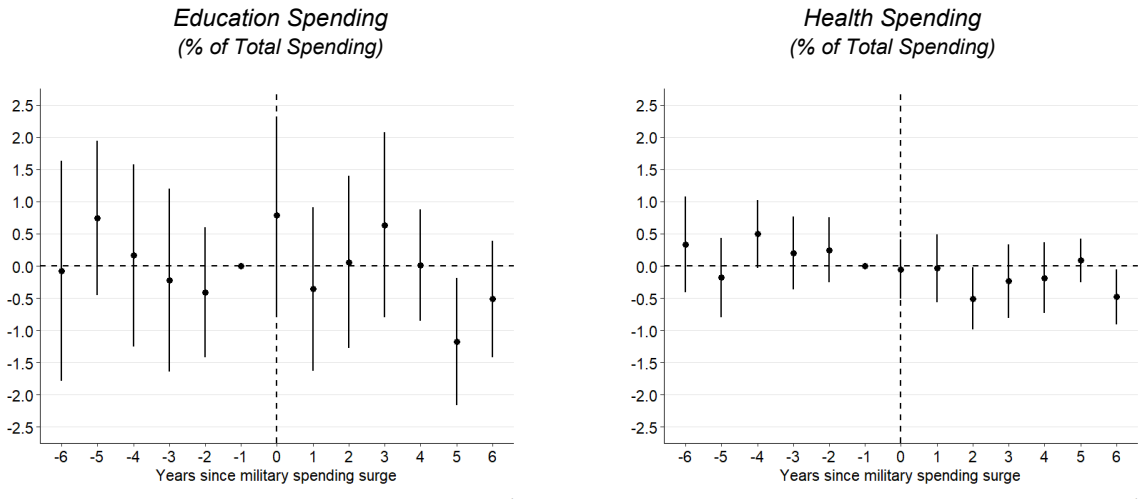
Figure 4a. Military Spending Surges (Local Projections)



Notes: The Figure depicts the effects of a surge in the share of military spending on total government spending on the shares of education and health in total government expenditure. Shaded areas indicate the 90 percent confidence interval using Driscoll-Kraay standard errors.

We also run event-study estimates to trace out the dynamic effects of military spending surges on health and education expenditures (Figure 4b). The results indicate that, prior to the surge, coefficients for both health and education spending shares fluctuate around zero and are generally statistically insignificant, suggesting the absence of systematic pre-trends. Following the surge (year 0), the estimated effects turn negative for both sectors. The decline is more persistent in the case of health spending, while education spending also exhibits negative point estimates in several post-surge years, albeit with wider confidence intervals. Overall, the evidence is consistent with a reallocation of public resources toward defense at the expense of health and education spending, although the magnitude and statistical precision of the effects vary across horizons.

Figure 4b. Military Spending Surges (Event Study)



Notes: The Figure depicts the effects of a surge in the share of military spending on total government spending on the shares of education and health in total government expenditure using event-study methods. Fixed-effects coefficient estimates and their 95% confidence intervals are reported.

Identifying Military Spending Shocks Through a Reaction Function

As an alternative approach, we attempt to identify "exogenous" shocks to military spending through a government spending policy reaction function in the spirit of Caldara and Kamps (2017). In practical terms, we use the residuals of the following regression for each country in our sample to identify military spending shocks. These residuals subsequently are plugged back into Equation 1 to estimate the effects on changes in the shares of education and health spending.

$$\Delta z_t = \alpha + \rho z_{t-1} + \sum_{i=0}^{2} \theta_i Ygap_i + \sum_{i=1}^{2} \omega_i (Debt/GDP)_{t-i} + \sum_{i=0}^{2} \vartheta_i Totgap_{t-i} + \sum_{i=0}^{2} \varphi_i (ODA/GDP)_{t-i} + \sum_{i=0}^{2} \gamma_i (fatalities/POP)_{t-i} + \varepsilon_t \quad (2)$$

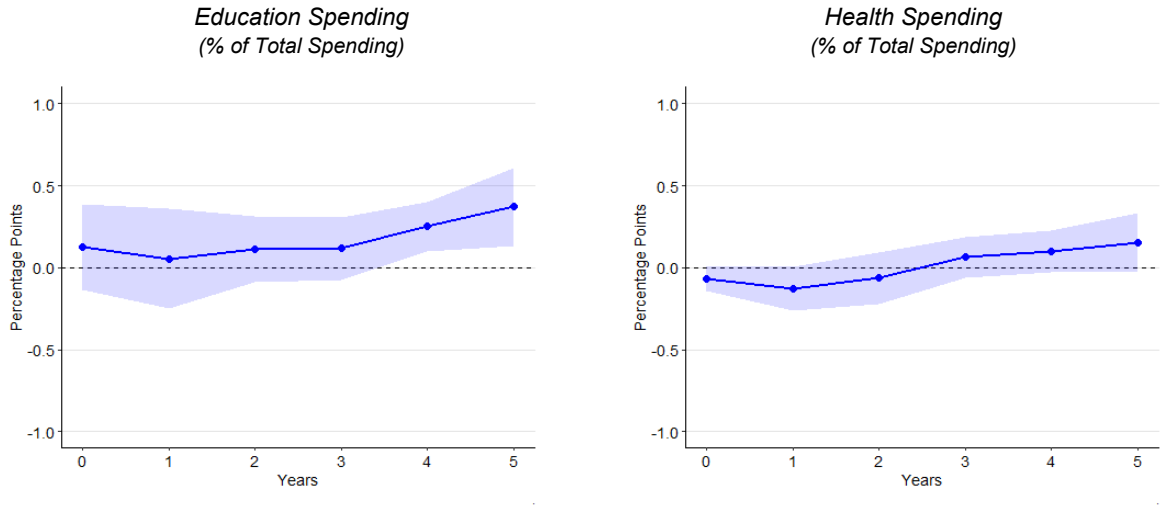
Where z_t is the share of military spending on total spending, α is constant and ε_t is the error term. Control variables include the output gap ($Ygap$), the terms of trade gap ($Totgap$), the debt to GDP ratio, the ratio of official development assistance to GDP and the number of fatalities per 1000 of population.

The implicit assumption in the identification strategy is that Equation 2 captures the structural component of the government's decision. In other words, non-structural components (i.e. the error terms in the regressions) are orthogonal to the variables of interest, namely changes in the shares of education and health spending. In essence, we are assuming that the government's military spending is systematically explained by the variables in Equation 2. As a result, the residual is the "surprise" element in military

spending, which is assumed to be exogenous. But this may not necessarily be the case in reality. We address this concern using the instrumental variable approach in the next section.

The results using this approach for the share of education and health spending on total spending are depicted in Figure 5 and suggest that crowding-out effects typically are neither statistically nor economically significant. A one standard deviation increase in the share of military spending leads to decreases in the share of health spending (right-hand-side panel) of less than 0.5 percentage point after one year, while the effect on the share of education spending is close to zero. There is some evidence of crowding-in over the medium-term, but the effects are small (again less than 0.5 percentage points) and are only statistically significant for education spending.

Figure 5: Effects of Military Spending Shocks (Reaction Function)



Notes: The Figure depicts the effects of a one standard deviation shock to the share of military spending in total government spending on the shares of education and health in total government expenditure. Shaded areas indicate the 90 percent confidence interval using Driscoll-Kraay standard errors.

Addressing Endogeneity through Instrumental Variables

In light of the mixed results presented thus far, in this sub-section we discuss the instrumental variable approach (our preferred method) used to address endogeneity issues that may have driven the results that were presented previously. Endogeneity may arise from contemporaneous reverse causality (for example, governments adjusting military spending in response to health or education needs) or from omitted variables such as security shocks that simultaneously influence both military and social spending. To mitigate these concerns, we use three instruments for military spending: (i) the value of weapons imports, (ii) the country's share of total military spending in Sub-Saharan Africa, and (iii) the U.S. producer price index for ammunition interacted with the value of military equipment imports from the U.S.[9] These three instruments leverage external and regional factors that shape defense budgets independently of social sector budget allocation, to strengthen the identification strategy. The selection of these instruments is constrained by data availability but guided by existing literature and economic rationale behind their relevance and validity.

First, the value of weapons imports is strongly correlated with military expenditure because imported arms represent a significant component of defense budgets in Sub-Saharan Africa. Yet, weapons imports are

[9] The U.S. ammunition PPI data are collected from the Federal Reserve Economic Data (FRED) while the weapon imports data come from SIPRI.

unlikely to directly affect domestic health or education spending except through its impact on overall military spending. Some studies have also used the value of weapons imports as an instrument for military spending to address endogeneity concerns. For example, Saeed (2025) uses SIPRI arms transfer data to instrument military expenditure, arguing that global arms trade patterns and price shocks influence defense allocations without directly affecting GDP growth.

Second, the country's share in regional military spending captures strategic positioning and regional security dynamics, which influence defense allocations but do not directly determine social sector spending. This approach aligns with burden-sharing models in security economics, where the military expenditure decisions of one country depend on the commitments and defense posture of its neighbors or regional bloc. Empirical evidence suggests that military spending in neighboring countries strongly predicts domestic defense budgets, making it a relevant instrument (Yesilyurt and Elhorst, 2017; Dunne and Smith, 2019; Du Bois, 2024).

Third, the interaction of U.S. ammunition PPI with weapon imports from the USA introduces exogenous price variation driven by global supply conditions rather than domestic policy choices. This instrument captures fluctuations in international arms markets that affect the price of imported military goods independently of a country's fiscal priorities for health and education. Because these price movements originate outside the domestic economy and are largely determined by U.S. manufacturing and global defense industry dynamics, they provide a source of variation in military spending that is plausibly unrelated to unobserved factors influencing social sector allocations, thereby satisfying the exclusion restriction.

The instrumental variable approach is applied with the local projection technique described in Equation 1 to capture the dynamic effects of military spending on health and education expenditures. In practice, we estimate the following regressions:

$$\Delta M_{i,t} = \pi_i + \kappa_t + \lambda` Z_{i,t} + \upsilon_{i,t} \quad (3) \text{ [First Stage]}$$

Where $\Delta M_{i,t}$ is the change in military spending as a share of total government spending for country i at time t, π_i and κ_t are country and year fixed effects respectively. $Z_{i,t}$ is a vector containing our three instruments and $\upsilon_{i,t}$ is the error term. We use the fitted value of our first stage $\Delta\widehat{M_{i,t}}$ and plug it in equation (1) which we estimate over for each horizon h:

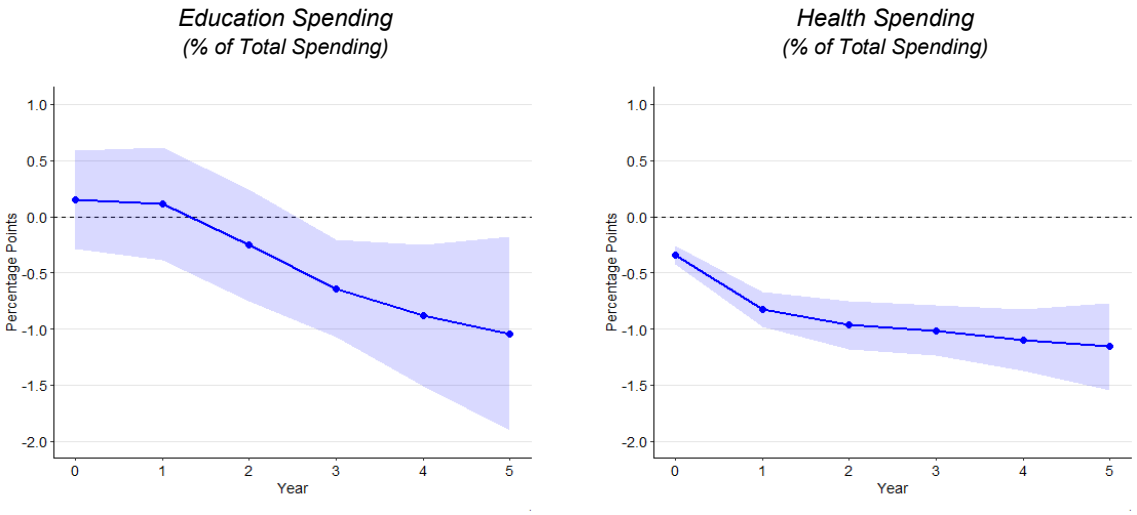
$$y_{i,t+h} - y_{i,t-1} = \alpha_i^h + \beta^h \Delta\widehat{M_{i,t}} + \delta X_{i,t} + \Theta_t^h + \epsilon_{i,t+h} \quad (4) \text{ [Second Stage]}$$

The regressor of interest is the share of military spending in total government expenditure, while the dependent variables are education and health spending as percentage of total government expenditure. The first-stage F-statistics, ranging from 9 to 16 across horizons and specifications, generally exceed the conventional threshold of 10, confirming the relevance of the selected instruments (Annex Table 3).[10] However, applying a stricter weak-instrument test proposed by Pflueger and Wang (2015) suggests that the econometric regressions may still suffer from weak identification. To address this concern, we implement the weak-instrument robust inference framework developed by Finlay, Magnusson, and Schaffer (2013).[11]

[10] Overall, the regressions also pass the Kleibergen–Paap under-identification test and the Hansen J over-identification test, providing evidence that the instruments satisfy the exclusion restrictions.

[11] To assess the sensitivity of our IV estimates to violations of the exclusion restriction, we apply the plausibly exogenous framework of Conley et al. (2012), allowing each instrument to have a direct effect on education spending of up to ±5 percent, across horizons. The results show that inference on the causal impact of military spending relies critically on the exclusion restriction, and the baseline IV estimates are not robust to violations of instrument validity.

Figure 6: Effects of Military Spending Shocks using Instrumental Variables



Notes: The Figure depicts the effects of a one-standard-deviation shock to the share of military spending in total government expenditure on the shares of education and health spending in total spending. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

As depicted in Figure 6, shocks to military spending appear to alter the relative allocation of government resources between sectors in a significant way. A one-standard-deviation increase in the share of military spending in total government expenditure does not seem to have an effect in the short-term, but it reduces the share of education spending by over 0.5 percentage points after three years and 1.1 percentage point after five years. In turn, increases in the military spending share lead to a decline of the share of health spending by about 0.8 percentage points after one year and nearly 1.3 percentage points after five years. This likely reflects differences in budget rigidities between the education and the health sectors. In Sub-Saharan Africa, a large share of education spending is devoted to salaries (teaching and non-teaching staff), which are rigid in the short term. By contrast, health budgets allocate a sizable share to operating costs (for instance, medicines, medical consumables, equipment maintenance) making health expenditure more flexible and thus more vulnerable to reallocations to accommodate military spending shocks in the short term.

4. Robustness Checks

Alternative Definitions of Key Variables

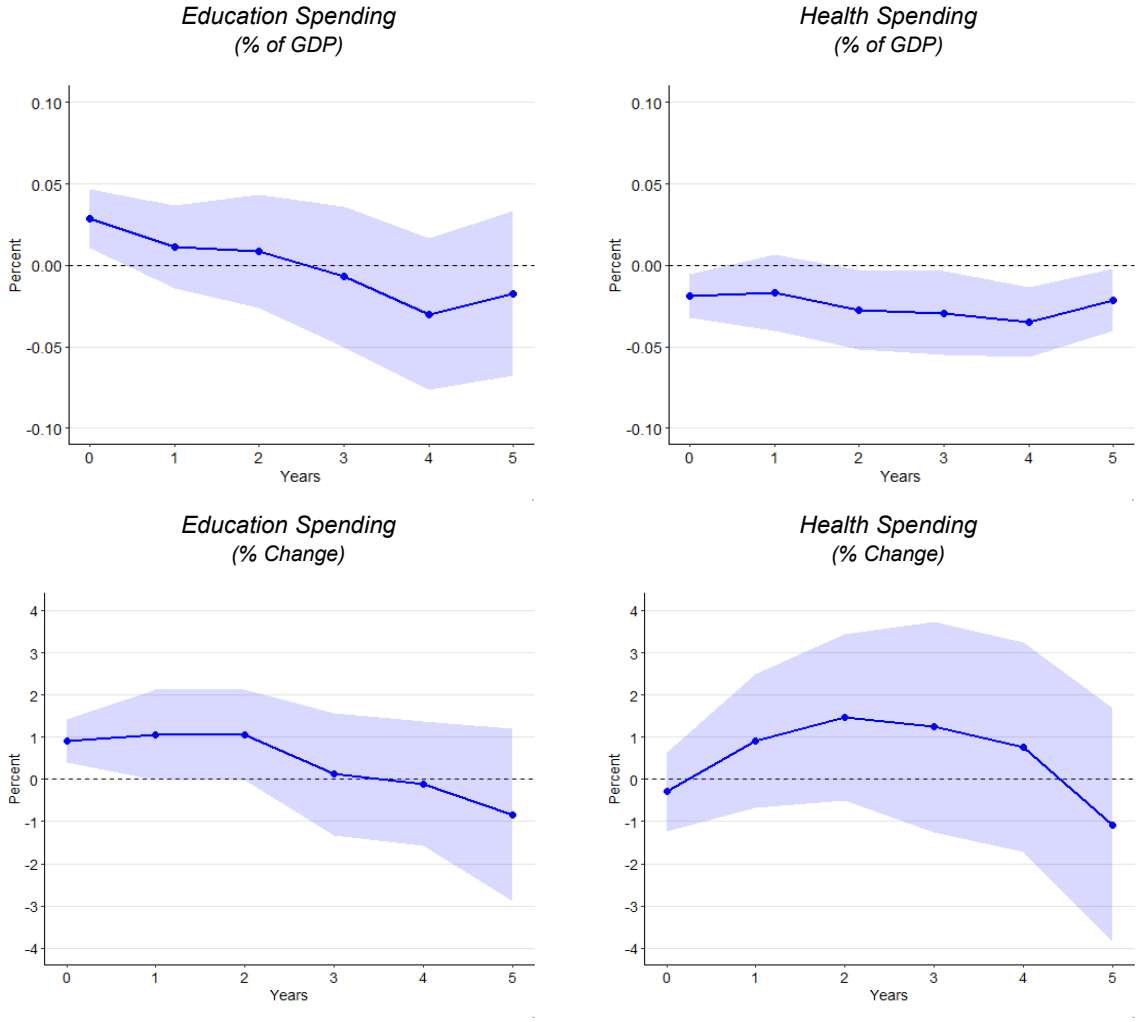
To test the robustness of our results, we first undertake an exercise for the approach that identifies military spending shocks through the reaction function, where we consider specifications that include military, education, and health spending as a share of GDP (rather than as a share of total spending). In addition, we also address the case where these variables are defined in real terms.[12] Equations 1 and 2 are adjusted accordingly.

Figure 7 illustrates that crowding-out effects remain limited when dependent variables are expressed as a share of GDP or in terms of real growth rates. As shown in the top half panels, a one standard deviation shock to military spending is not associated with any (economically and statistically) significant changes in the ratio of education spending to GDP after two years, while health spending declines by less than 0.1

[12] More specifically, military spending is included in constant 2023 dollars, education spending is defined as government spending per school age child and health spending is defined as government spending on health per capita (both expressed in dollar terms).

percent of GDP. Similarly, the bottom half panels indicate that a one standard deviation real increase in military spending is not linked to significant changes in education and health spending after two years (even if on impact there is an economically very small increase in education spending). Overall, military shocks identified through this reactions function approach do not point to large crowding-out effects on education and health spending over the near term.

Figure 7: Effects of Military Spending Shocks (Reaction Function)



Notes: The Figure depicts the effects of a one standard deviation military spending shock. The top panels show the model with variables expressed as a share of GDP and the bottom charts the models with the variables expressed in real percentage changes. Shaded areas indicate the 90 percent confidence interval using Driscoll-Kraay standard errors.

In addition, we perform a similar exercise for the instrumental variables approach (Figure 8).[13] We find crowding-out effects on health spending expressed as percentage of GDP, with a one-standard-deviation increase in military spending as a share of GDP reducing health expenditure by about 0.5 percentage points after five years. We do not find evidence of significant crowding-out effects of increases in total military spending on education expenditure per school-age child or health spending per capita (in line with the results presented in other sections). This means that while absolute spending levels may remain

[13] An additional robustness check on instrument selection is reported in Annex Figure 2. The findings show that the baseline results are not robust to the exclusion of any of the instruments, underscoring the relevance of each of the three instruments.

stable, military spending shocks trigger an adjustment of fiscal priorities away from social sectors, highlighting the trade-offs governments face between security and human capital investment. This reallocation, however, does not necessarily lead to a substantial reduction in the absolute resources available for delivering social services.

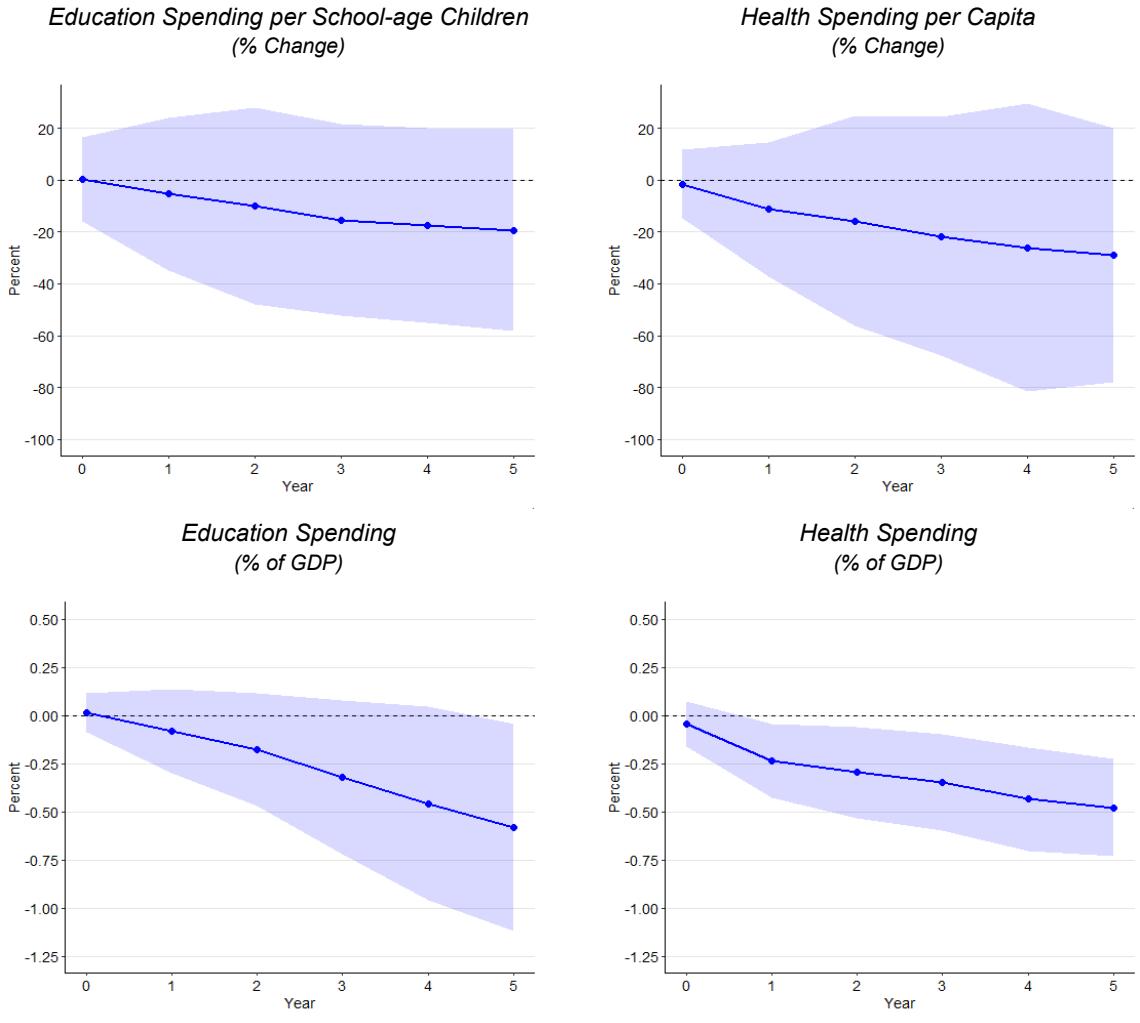
Increased military spending may not result in decreases in social spending in part because nominal, and to some degree per-capita levels of spending, are “sticky” for various institutional reasons, including the relative high share of wage-related expenditures that cannot be easily reduced. Another plausible explanation for this finding is that overall government expenditure increases due to the positive multiplier effect of military spending on GDP growth. As noted previously, in the context of sub-Sharan African economies, military spending is likely to have a high import content, given the fact that countries typically are not producers of military equipment. Therefore, additional spending will probably translate into a less than proportional domestic demand stimulus in the short-term, as there would be at least some “leakages” through higher imports.[14] Nonetheless, as discussed in the introduction, in addition to direct demand stimulus, military spending may also boost growth by reducing insecurity and overall economic uncertainty associated with it.

To further assess whether the pandemic may have altered the crowding-out effects of military spending on education and health expenditures, we re-estimated the instrumental-variables specification using a sample restricted to the pre-COVID-19 period. Results are broadly robust across key variable definitions, suggesting that the pandemic did not influence the relationship between military spending and education and health expenditures.[15]

[14] The estimation of defense spending GDP multipliers is beyond the scope of the paper.

[15] Results are available upon request.

Figure 8: Effects of Military Spending Shocks using Instrumental Variables

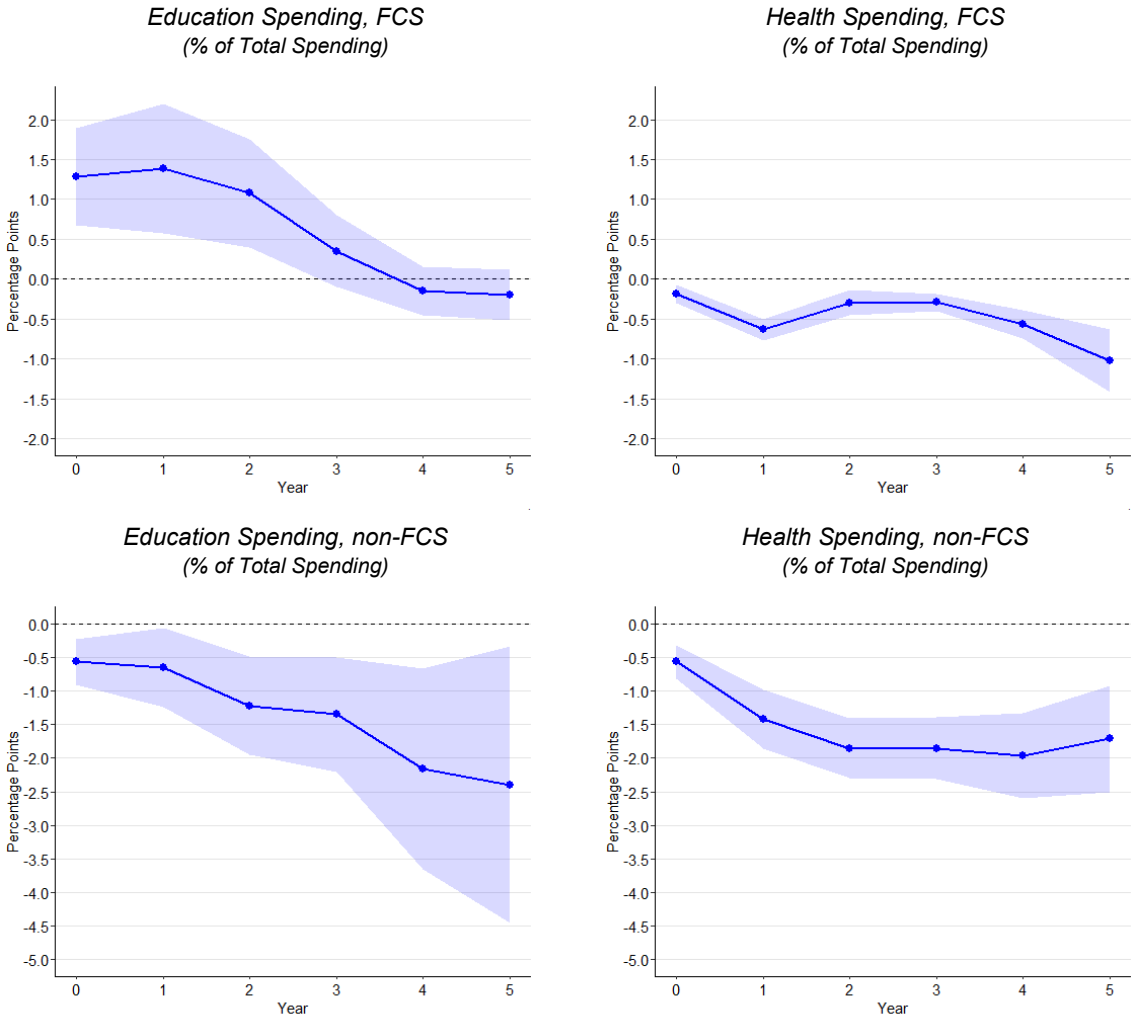


Notes: The Figure depicts the effects of a one-standard-deviation shock to: (i) total military spending on education spending per school-age child and health spending per capita; and (ii) military spending as a percentage of GDP on education and health spending as share of GDP. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

Fragility and Conflict

We also investigate whether the effects of military spending differ between FCS and non-FCS countries. Indeed, crowding-out is likely to be salient in countries facing tighter financing constraints, greater security issues and weaker management capacities which make the substitution of social spending for military spending more of a concern. Figure 9 presents the IV estimation results separately for FCS and non-FCS, based on the IMF's fiscal year 2026 classification. In non-FCS, military spending shocks clearly crowds-out health and education expenditures (bottom charts), while in FCS crowding-out effects are not as apparent, especially in the education sector, perhaps illustrating increased donor support that often accompanies heightened security concerns in fragile contexts. The results remain broadly similar when comparing countries experiencing active conflict with those without conflict and are not reported here to save space. Similarly, removing the Sahel countries from the sample does not significantly alter the results. These results are available upon request.

Figure 9: Effects of Military Spending Shocks in FCS and non-FCS (IV Approach)



Notes: The top panel illustrates the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the share of education and health spending in FCS while the bottom panel shows the effects of the same shock in non-FCS. IMF FCS classification for fiscal year 2026 was used for this categorization. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

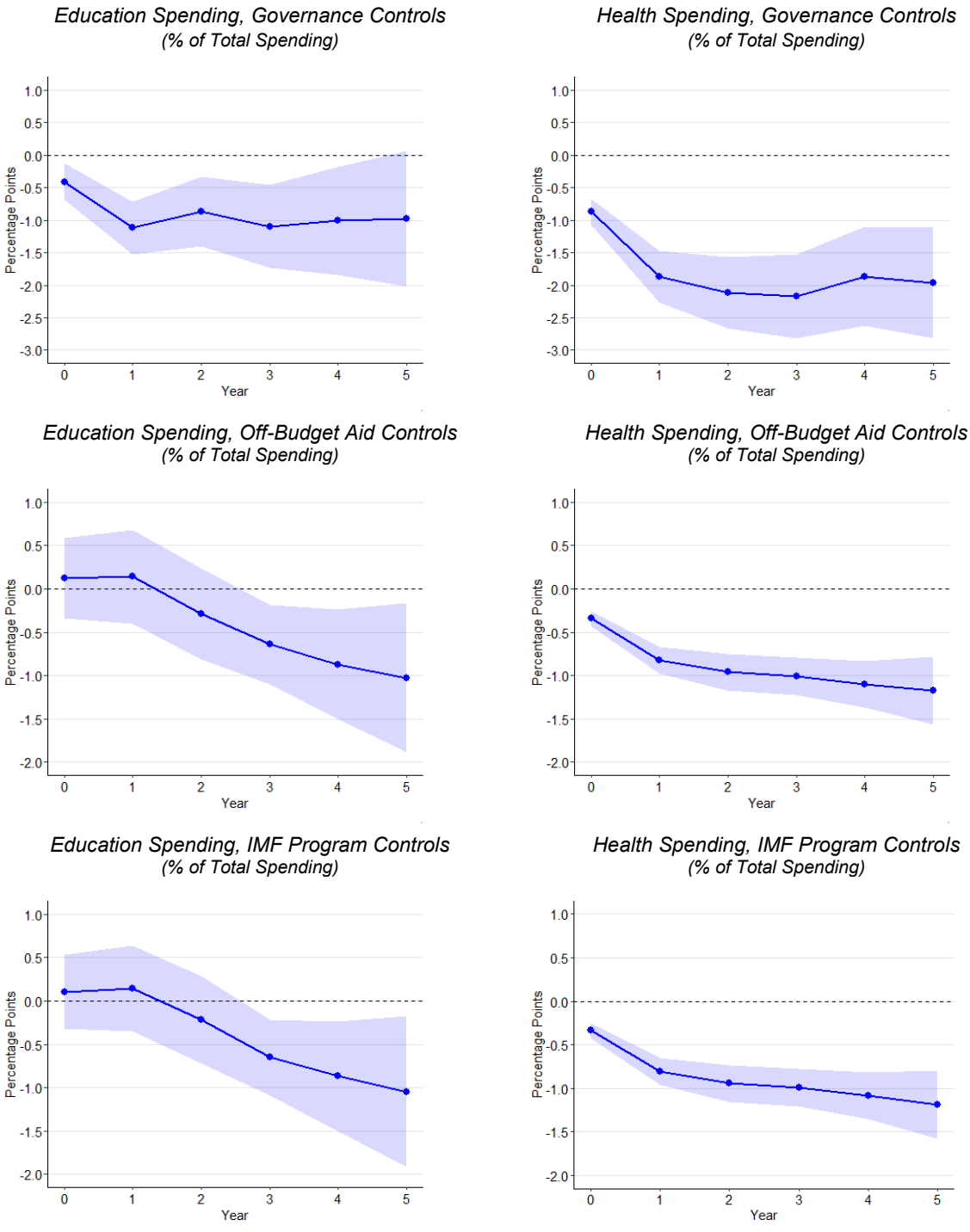
Additional Control Variables

As a final robustness check, we assess whether controlling for additional factors, such as governance (control of corruption), the level of off-budget aid to education and health and the presence of an IMF program, change the baseline results. During crises, development partners may increasingly deliver assistance outside of government budgets. Off-budget aid can constitute a substantial share of total education and health official development assistance in some countries and may not be included in government statistics and therefore be omitted from our baseline specification. Governance levels may also influence the ability of countries to handle fiscal pressures. In addition, IMF programs often include a floor on social sector spending and may play a role in containing education and health spending declines.

As shown in Figure 10, the crowding-out effects are robust to the inclusion of control variables, such as governance (top two panels), off-budget aid (middle panels) and the presence of IMF programs (bottom

panels). Nonetheless, the magnitude of the coefficients is somewhat reduced compared to the baseline estimates.

Figure 10: Effects of Military Spending Shocks with alternative control variables (IV approach)



Notes: The top panel illustrates the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the share of education and health spending with governance (control of corruption) as an additional control variable; the middle panel controls for off-budget health and education ODA; the bottom panel controls for whether the country has an IMF program. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

5.State Dependencies

In this section, we examine how the relationship between military and social spending varies with state-dependent factors, including those related to government debt, ODA, and the business cycle, focusing on the preferred approach where shocks are identified through instrumental variables. [16] These state dependencies are critical because they are key determinants of fiscal flexibility and policy trade-offs. For instance, high debt levels can constrain governments' ability to accommodate rising military spending without cutting human capital investment, while ODA flows may buffer these pressures by providing external resources for education and health. The business cycle could also influence revenue performance and spending capacity and therefore affect the trade-offs between military and social spending. To capture these nonlinear effects, we use a smooth transition function (Auerbach and Gorodnichenko, 2012) as follows:

$$y_{i,t+h} - y_{i,t-1} = \left(1 - F\left(z_{i,t-1}\right)\right)\left[\alpha^h_{high,i} + \beta^h_{high} shock_t + \delta_{high} X_{i,t} + \gamma_{high}\Theta^h_t\right] + \left(F\left(z_{i,t-1}\right)\right)\left[\alpha^h_{low,i} + \beta^h_{low} shock_t + \delta_{low} X_{i,t} + \gamma_{low}\Theta^h_t\right] + \mu_{i,t+h} \quad (5)$$

with $F\left(z_{i,t-1}\right)$ being a smooth function of the state variable, and z a normalized version of the state variable such that $F(0) = \frac{1}{2}$. Consistent with the literature, we assume the following functional form for

$$F\left(z_{i,t-1}\right) = \frac{e^{-\tau_0 Z_{i,t-1}}}{1 + e^{-\tau_0 Z_{i,t-1}}}$$

This specification allows the fiscal response to military spending shocks to vary gradually across different states rather than assuming abrupt regime shifts. The parameter τ_0 controls the smoothness of the transition, with a higher value producing sharper shifts and a lower value resulting in a more gradual change between states. For our analysis, τ_0 is set to 2.[17] The smooth transition function is applied to the instrumental variable specification discussed in the previous section.

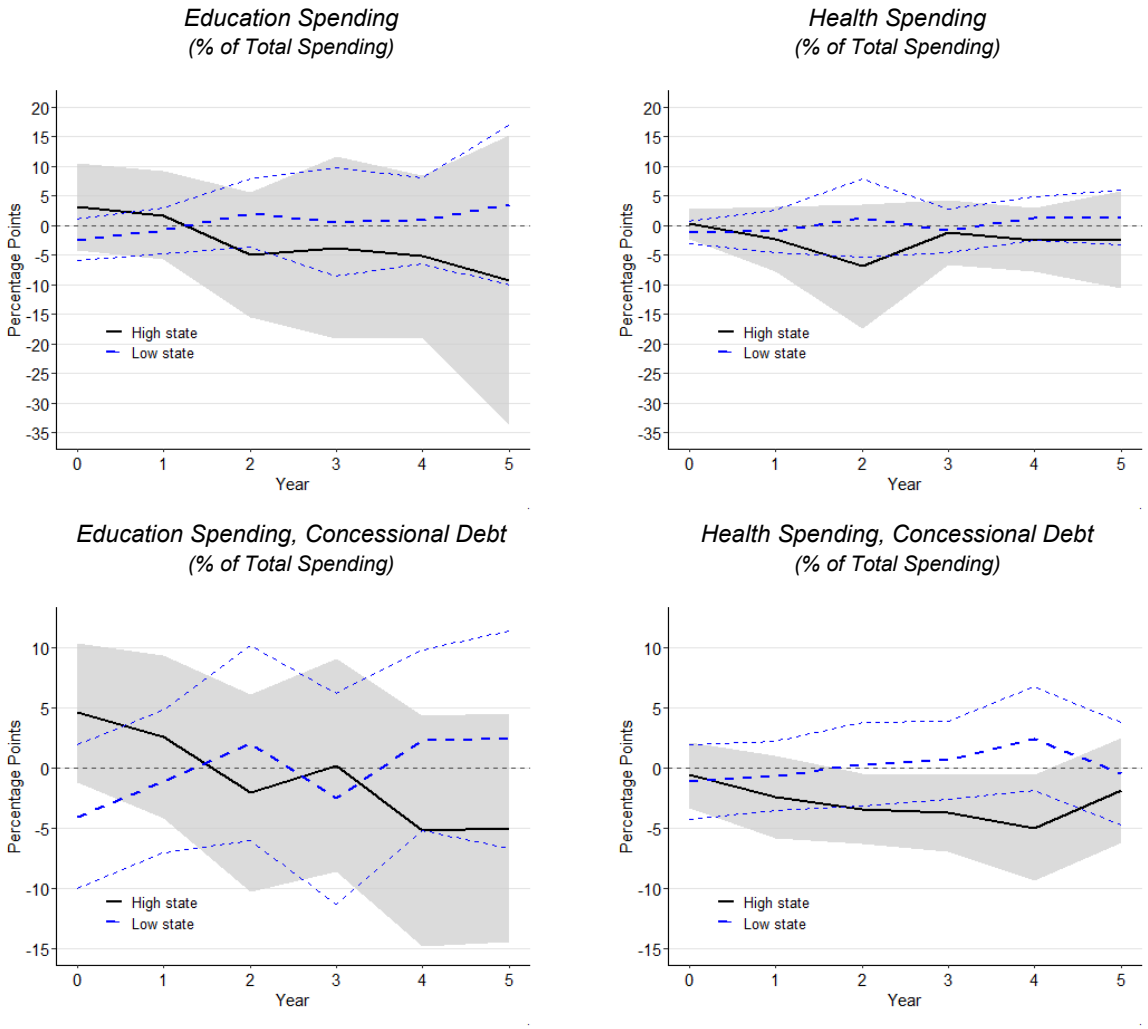
Government Debt

We begin by analyzing results for high and low levels of debt. Estimates from Equation 5 indicate that a high debt-to-GDP ratio does not necessarily render social spending more vulnerable to military spending shocks (Figure 11). This may be linked to the fact that governments with strong credibility can sustain higher debt levels i.e. a high debt to GDP ratio may be an indicator of market access (Lemaire, Nyankiye, and Sode, 2023). By contrast, when considering only the non-concessional component of external debt, while the results for education remain similar, there is some evidence of larger crowding-out effects of military spending on health expenditure when the non-concessional debt to GDP ratio is high. In other words, countries with limited access to concessional financing are more likely to experience crowding-out effects of military spending in the health sector.

[16] We examined governance-related state dependencies using the World Bank's CPIA (Country Policy and Institutional Assessment) and the World Governance Indicators and found no statistically significant differences in the crowding-out effects of military spending between low- and high-governance states.

[17] The choice of the smoothness parameter is based on judgement and follows common practice in the literature. While alternative values could be used, sensitivity analysis typically shows that results are robust to moderate changes to this parameter (see Annex Figure 1).

Figure 11: Effects of Military Spending Shocks and Government Debt (IV Approach)



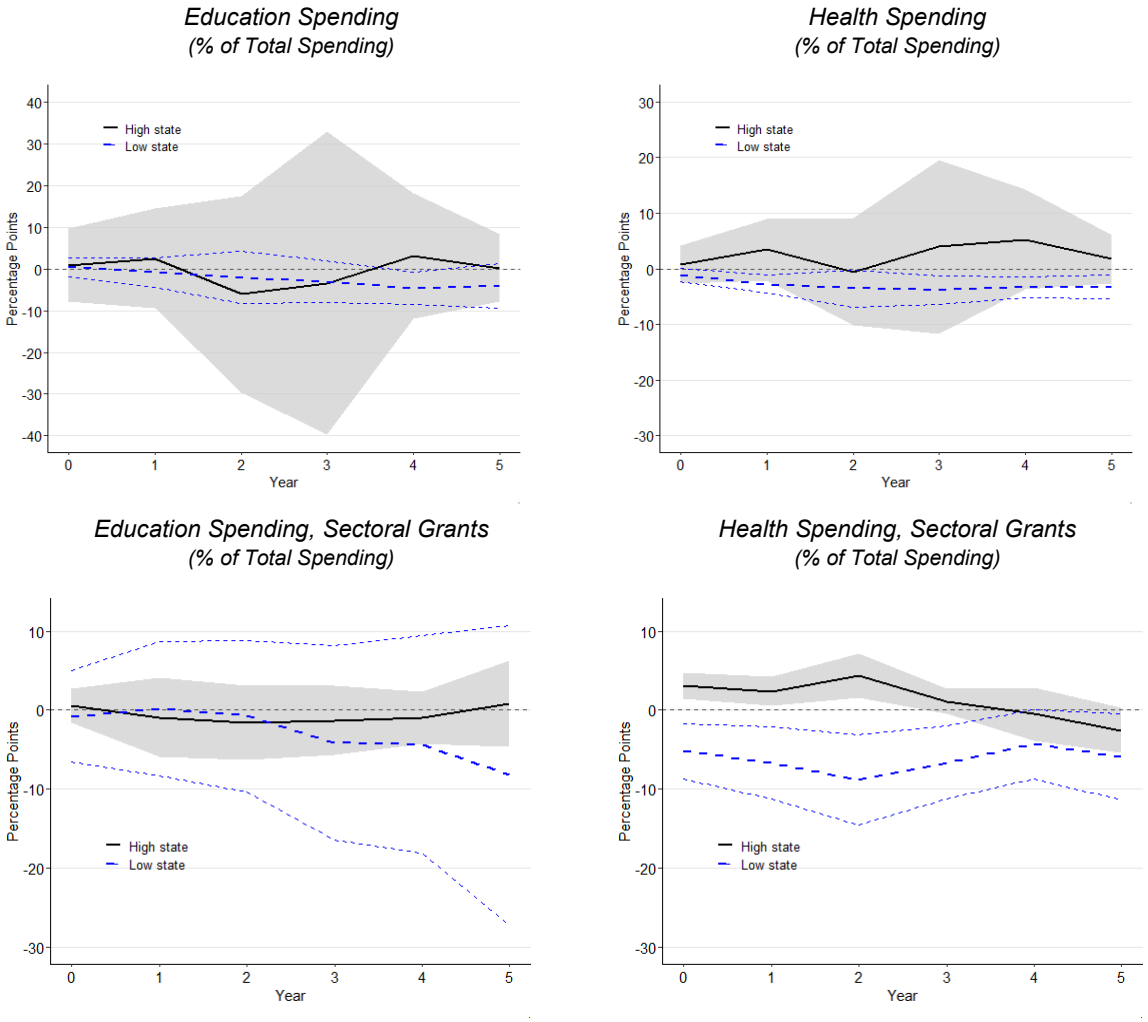
Notes: The top panel depicts the effects of a one-standard-deviation shock to military spending as a share of total government expenditure on the share of education and health spending in two states: (i) high debt to GDP and (ii) low debt to GDP ratio. The bottom panel shows the results of the same shock, comparing high and low non-concessional debt to GDP ratio. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

Foreign Aid

Next, we turn to foreign aid. The results suggest that while there are no significant differences regarding the effects of military spending shocks on education expenditures across high and low periods of official development assistance, military spending shocks tend to crowd-out health expenditure, when access to ODA is limited (Figure 12, top panels). In particular, the crowding-out effect on health expenditures is more pronounced when ODA grants to the health sector are lower (Figure 12, bottom panels). Countries with limited donor support must reallocate scarce domestic resources, frequently cutting social sector spending to meet urgent military needs. However, there is also evidence of crowding-in effects in the health sector when access to ODA grants are higher. This may be linked to the fact that countries with strong donor engagement tend to attract additional resources into the health sector following a security shock. In these “donor darlings,” crises often trigger a rapid response from development partners, who

reallocate or scale up aid to protect social spending thus preventing negative effects on the population's health.[18] This finding also suggests that countries that succeed in securing external financing during periods of security challenges may adjust fiscal priorities in favor of health to safeguard essential services and ensure continued investment in human capital.

Figure 12: Effects of Military Spending Shocks and ODA (IV Approach)



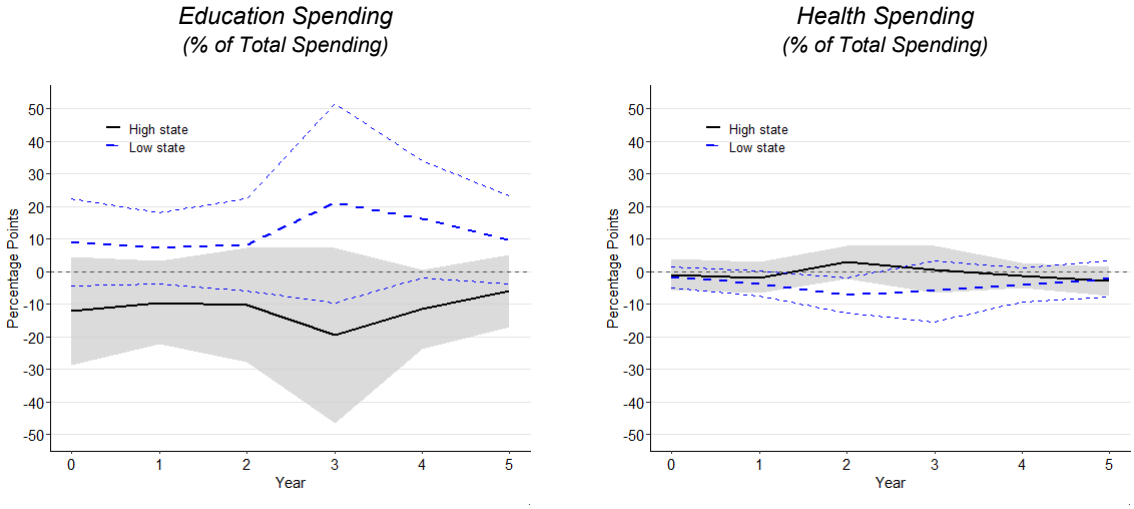
Notes: The top panel depicts the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the shares of education and health spending in countries with high ODA (high state) and those with low ODA (low state). The bottom panel presents the effects of the same shock in countries receiving high levels of ODA grants allocated to the education sector (education-related chart) and to the health sector (health-related chart), compared with countries receiving low levels of ODA grants to these sectors. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

[18] The education and health spending variables include donor financing channeled through the government budget. Off-budget donor support (e.g., direct project implementation by donors) is excluded.

Business Cycle

The effects of military spending on the shares of education and health spending do not vary significantly with the business cycle (Figure 13). In other words, whether the economy operates above or below potential does not significantly influence the potential crowding-out or crowding-in effects of military spending on education and health expenditure. This illustrates that fiscal trade-offs between defense and social spending are shaped primarily by structural factors rather than cyclical conditions.

Figure 13: Effects of Military Spending Shocks and Business Cycle (IV Approach)



Notes: The Figure depicts the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the shares of education and health spending in two states under two conditions: positive output gap (high state) and a negative output gap (low state). Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

6.Conclusions

In this paper, we use different approaches to quantify the effects of increases in military spending on education and health spending in sub-Saharan African countries. We find evidence of crowding-out effects when exogenous military spending increases are carefully identified through instrumental variables. The results show that shocks to military spending alter the relative allocation of government resources to social sectors in a significant way. A one-standard-deviation increase in the share of military spending in total government expenditure reduces the shares of education and health spending by about one percentage points over the medium-term. The crowding-out effects tend to materialize sooner for health expenditures.

Moreover, the results also suggest that military spending shocks tend to crowd-out health expenditures when access to international aid is limited, while there is no evidence of crowding-out when aid is amply available. In contrast, it appears that overall debt levels and the state of the business cycle are not significant factors in determining the extent of crowding-out effects. We also find evidence that crowding-out is somewhat more limited when variables are measured as a share of GDP or in real terms (rather than as a share of total spending), which suggests that military spending shocks primarily reshape the allocation of fiscal priorities. Nevertheless, it is important to note that a reallocation away from social spending could be concerning (even if there is no significant reduction in absolute terms), given that there are important service delivery gaps in several countries in the region.

These findings highlight the need for policy mechanisms that insulate social sector budgets from security-related fiscal pressures. In the short-term, these could take the form of social expenditure floors in the budget. Over the medium-term, the literature suggests that deeper reforms enhancing governance, institutions and public financial management would be essential to improve the predictability of social sector spending and to make progress on key social outcomes (Gupta, Schena, and Yousefi, 2020). Without these reforms, a potential reallocation of resources away from the education and health sectors could weaken human capital accumulation, erode workforce skills and labor productivity, which would ultimately lower economic growth potential and shift its long-term growth trajectory onto a permanently weaker path. Finally, the evidence presented here is especially timely in the context of shifting priorities in development partners and reduction of ODA, as policy makers should be alert to the social repercussions of military expansion which are more likely to materialize in low aid environment.

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Annex

Annex Table 1. Variables and Source Datasets

Variable	Description	Source
Arms Transfers	Annual volume of international transfers of major conventional weapons (imports/exports or bilateral flows). Typically measured using SIPRI TIV (a volume/capability metric, not financial value).	SIPRI Arms Transfers Database
Education Spending (% of GDP or % of total expenditures)	Government expenditure on education, expressed either as a share of GDP or as a share of total government spending (depending on the series used).	Gethin (2024)
Debt-to-GDP ratio	Stock of public debt expressed as a percentage of GDP.	GMD (Global Macro Database) , IMF WEO
Fatalities per 1,000 people	Total conflict-related deaths recorded in ACLED over a period, divided by population and scaled per 1,000 people.	ACLED
Health Spending (% of GDP or % of total expenditures)	Government expenditure on health, expressed either as a share of GDP or as a share of total government spending (depending on the series used).	Gethin (2024)
Military Spending (% of GDP or % of total expenditures)	National military expenditure (as defined by SIPRI), expressed as a share of GDP or as a share of total government spending	SIPRI Military Expenditure Database (Milex)
Official Development Assistance (% of GDP)	Net official development assistance received, scaled by GDP.	World Bank WDI
Output Gap (HP-filter)	Percent deviation of log real output from its HP-filtered trend (trend computed by authors; gap expressed in percent).	IMF WEO, authors' calculations

Variable	Description	Source
Arms/Ammunition Producer Price Index	Producer Price Index for arms/ammunition-related products (BLS PPI series accessed via FRED; exact series depends on whether you use an "industry" or "commodity" PPI for ammunition).	FRED (BLS PPI via FRED)
Terms of Trade Gap (HP-filter)	Percent deviation of the terms-of-trade index from its HP-filtered trend (trend computed by authors; gap expressed in percent).	WDI, authors' calculations
VIX (Volatility Index)	Market-implied near-term (≈30-day) expected volatility for the S&P 500 derived from option prices (the "fear gauge").	Bloomberg (VIX)
10-year US Treasury Yield	Yield on the 10-year US Treasury benchmark (typically end-period or average, depending on the series pull).	Haver

Annex Table 2. Summary Statistics for Military Spending Shocks

Shock Identification	Observations	Countries	Mean	Standard deviation	Minimum	Maximum
Military Spending Surges	853	30	0.18	0.39	0	1
Reaction Function:	560	34	0	0.74	-4.87	6.02
IV:	582	30	-0.12	1.35	-8.63	13.9

Annex Table 3. Instrument test results for the baseline local projections model in Figure 6

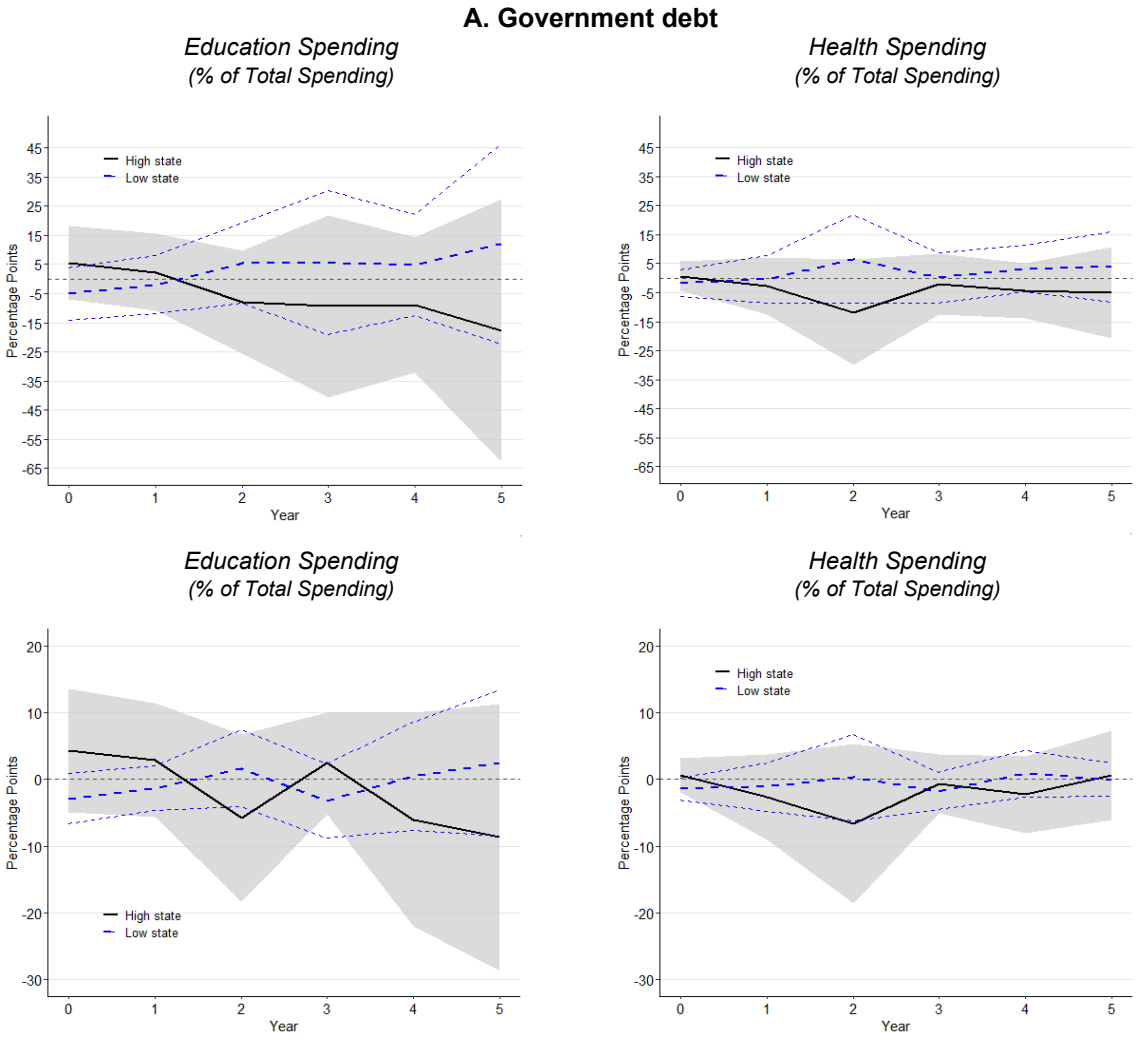
Education

	Weak instrument test			Instrument validity test		
Horizon	Cragg-Donald Wald F statistic	Stock-Yogo weak ID F test critical value assuming 10% maximal IV relative bias	Weak identification (F statistic below Stock and Yogo critical value)	Hansen J statistic (overidentification test of all instruments)	Hansen J Chi-sq (2) P-val	Validity concerns (null hypothesis of overidentification not rejected at 5 % test level)
1	16.08	9.08	No	5.091	0.0785	No
2	16.08	9.08	No	1.484	0.4760	No
3	13.85	9.08	No	0.258	0.8792	No
4	12.66	9.08	No	0.439	0.8031	No
5	11.81	9.08	No	2.375	0.3050	No

Health

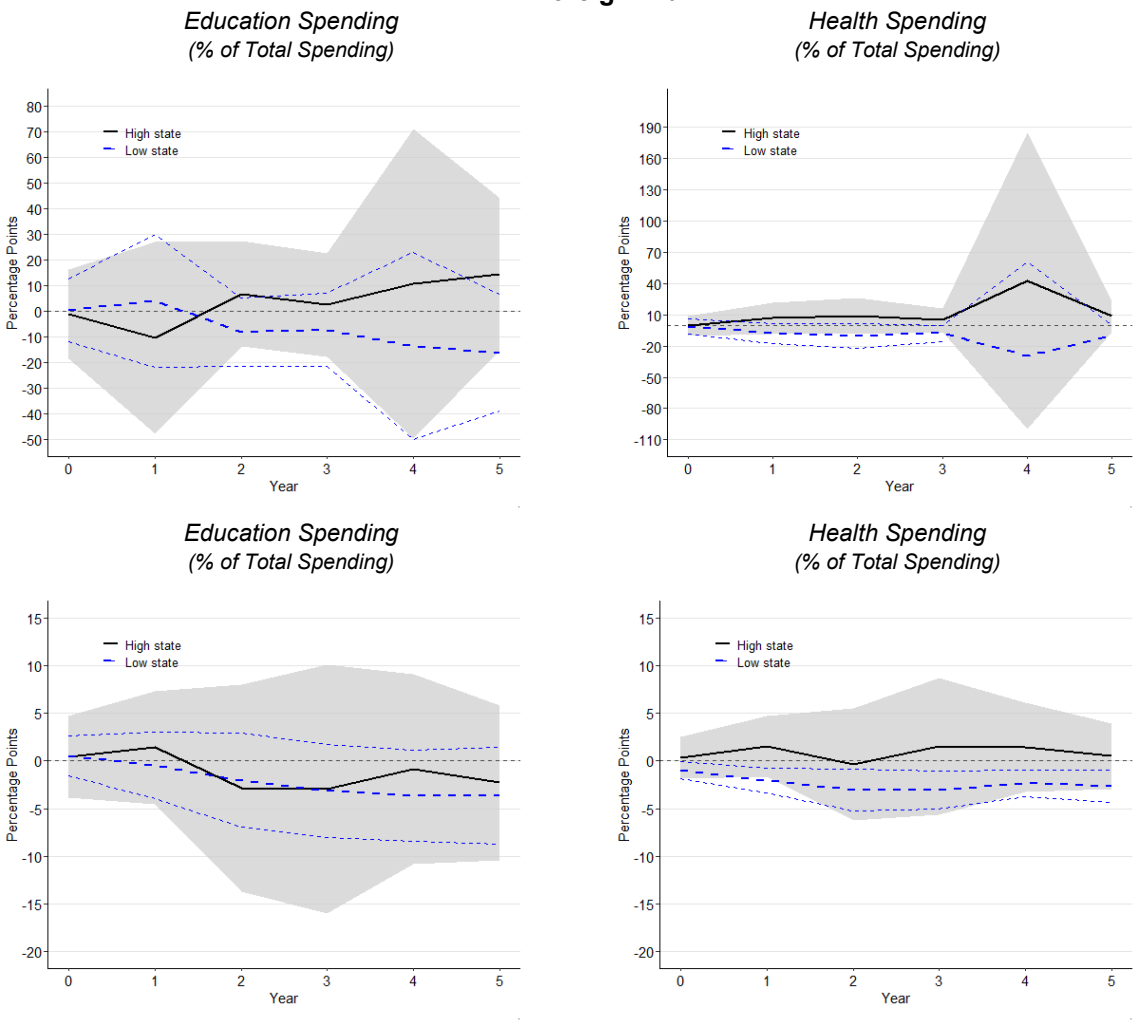
	Weak instrument test			Instrument validity test		
Horizon	Cragg-Donald Wald F statistic	Stock-Yogo weak ID F test critical value assuming 10% maximal IV relative bias	Weak identification (F statistic below Stock and Yogo critical value)	Hansen J statistic (overidentification test of all instruments)	Hansen J Chi-sq (2) P-val	Validity concerns (null hypothesis of overidentification not rejected at 5 % test level)
1	11.53	9.08	No	2.224	0.3289	No
2	11.53	9.08	No	2.683	0.2614	No
3	10.43	9.08	No	0.475	0.7888	No
4	9.83	9.08	No	1.000	0.6066	No
5	9.32	9.08	No	2.112	0.3478	No

Annex Figure 1 Sensitivity analysis for the smooth transition function



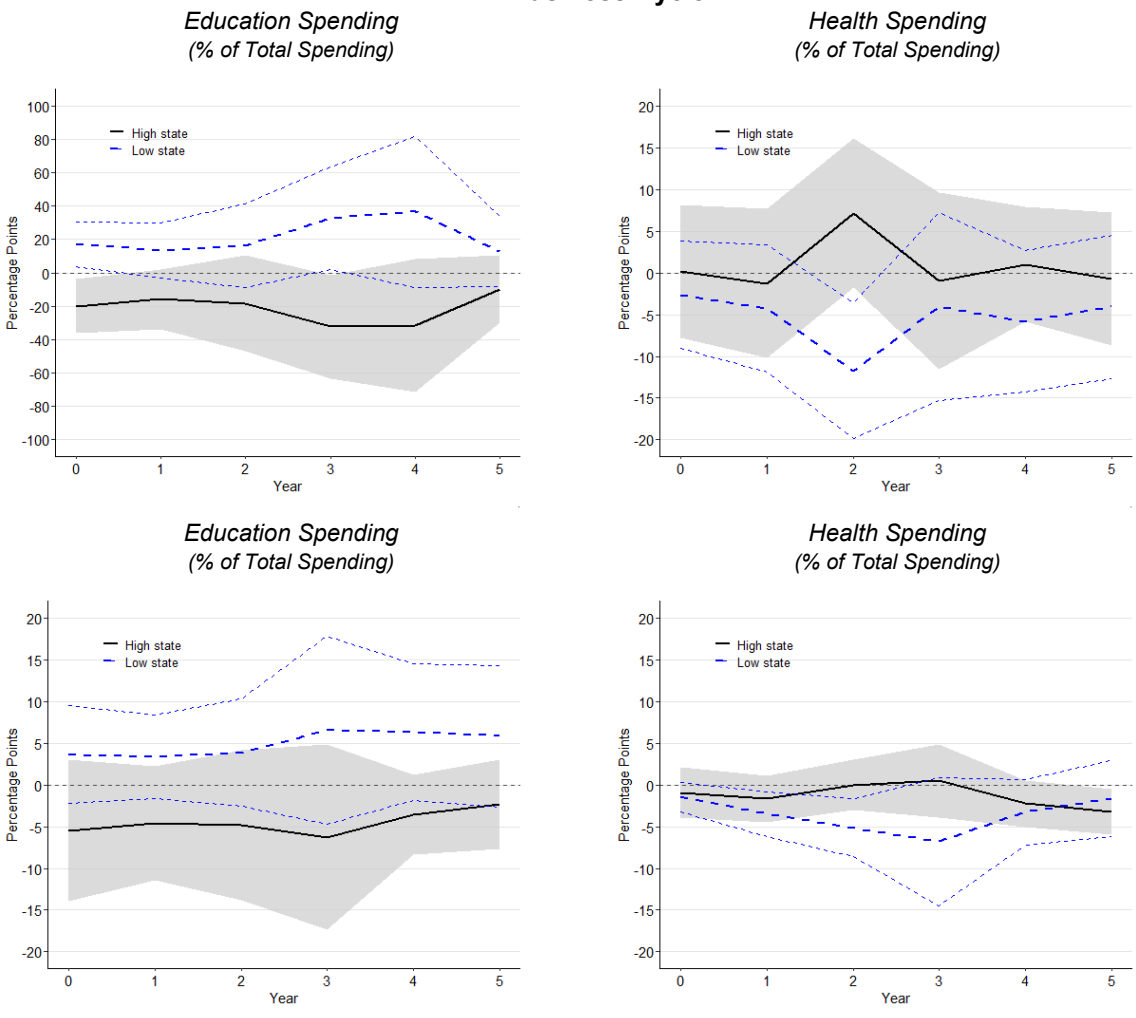
Notes: The figure depicts the effects of a one-standard-deviation shock to military spending as a share of total government expenditure on the share of education and health spending in two states: (i) high debt to GDP and (ii) low debt to GDP ratio. The parameter τ_0 of the smooth transition function was set at 0.5 in the top panel and 3.5 in the bottom panel. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

B. Foreign Aid



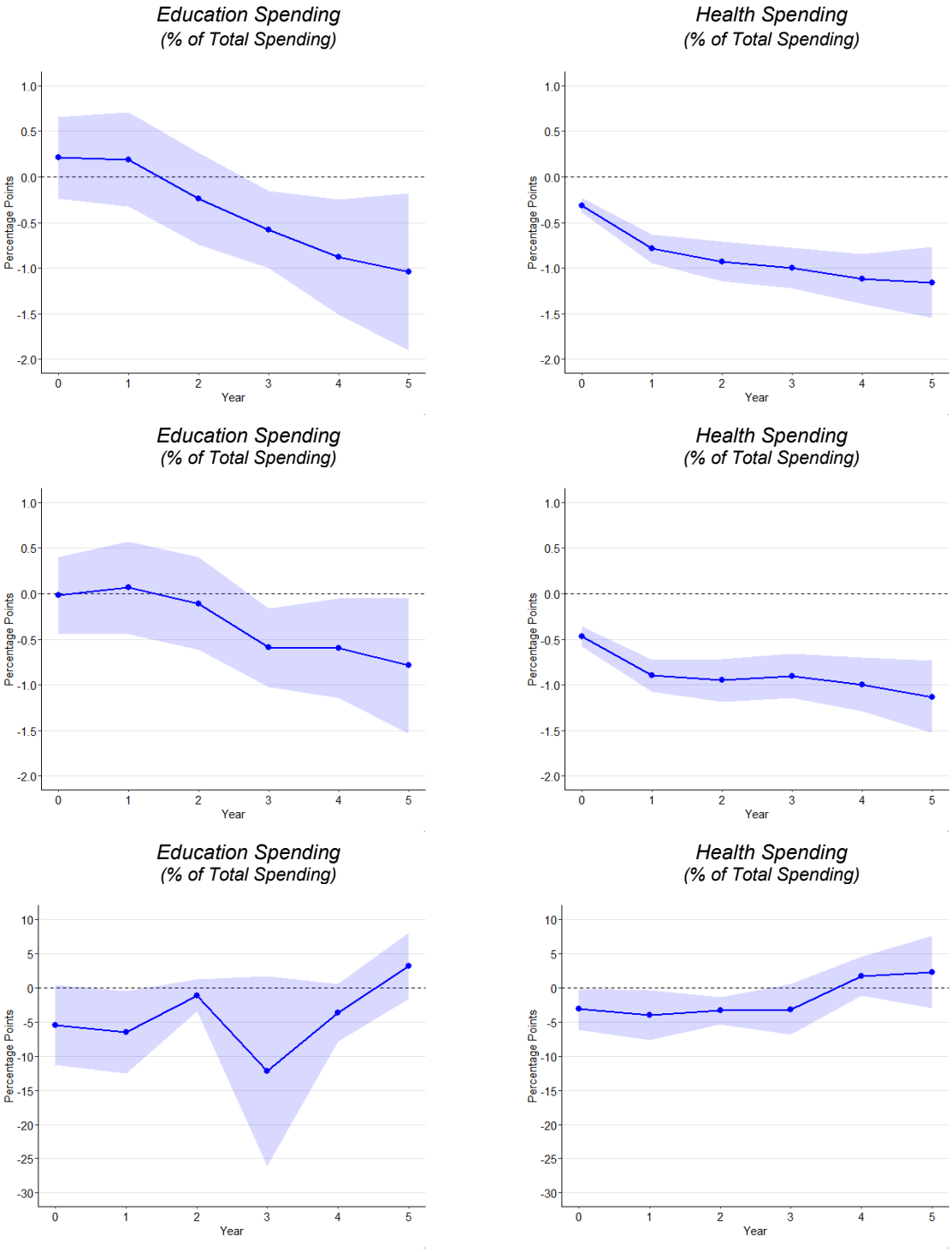
Notes: The figure depicts the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the shares of education and health spending in countries with high ODA (high state) and those with low ODA (low state). The parameter τ_0 of the smooth transition function was set at 0.5 in the top panel and 3.5 in the bottom panel. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

C. Business Cycle



Notes: The Figure depicts the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the shares of education and health spending in two states under two conditions: positive output gap (high state) and a negative output gap (low state). The parameter τ_0 of the smooth transition function was set at 0.5 in the top panel and 3.5 in the bottom panel. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

Annex Figure 2 Robustness check with alternative selection of instruments



Notes: The top panel illustrates the effects of a one-standard deviation shock to military spending as a share of total government expenditure on the share of education and health spending, removing the value of weapons imports among the instruments; the middle panel removes the interaction of U.S. ammunition PPI with weapon imports from the USA among the instruments; the bottom panel excludes the country's share in regional military spending. Shaded areas indicate the 90 percent confidence interval using Finlay, Magnusson and Schaffer (2013) weak-instrument-robust confidence intervals.

PUBLICATIONS

Military Spending and Crowding-Out Effects: Evidence from Sub-Saharan Africa

Working Paper No. WP/2026/069