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## Fiscal Consolidation and Development in Sub-Saharan Africa

NEPHTHALI CIBANGU

MANASSÉ MULUNDA

ISHARA MUSIMWA

JEAN-PAUL K. TSASA

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CIREM – Centre Interuniversitaire de Recherche en Économie Mathématique  
Université Protestante au Congo (Campus du Centenaire)

Adresse : Croisement des avenues de Libération et, Boulevard Triomphal,  
B.P. 4745 Kinshasa II, Lingwala, RDC

Email : [cirem@upc.ac.cd](mailto:cirem@upc.ac.cd)

Site web : <https://cirem.upc.ac.cd>

Tél. : +243 81 94 93 358

X : @CIREMath

# Fiscal Consolidation and Development in Sub-Saharan Africa\*

Nephthali Cibangu<sup>†</sup>    Manassé Mulunda<sup>‡</sup>    Ishara Musimwa<sup>§</sup>

Jean-Paul K. Tsasa<sup>¶</sup>

## Abstract

We examine the effects of fiscal consolidation on the development process. We draw on the newly constructed narrative dataset of Abdel-Latif, Bechchani, David, and Lemaire (2026a), which documents discretionary fiscal adjustment episodes across 14 Sub-Saharan African countries over 1990–2024. We estimate panel local projections to trace the dynamic responses of the HDI and its three sub-indices, i.e., health, education, and income, following consolidation episodes. We find that a fiscal consolidation of 1% of GDP reduces human development by approximately 0.25% after one year, deepening monotonically to about 0.46% after three years, with the education sub-index bearing the sharpest and most persistent deterioration, while the health sub-index contracts most on impact but only transitorily. In addition, the sensitivity of each HDI component to fiscal contraction is heterogeneous. We also find the composition of adjustment matters: tax-based consolidations are more damaging to human development than equivalent expenditure-based ones for the aggregate HDI and for the health and education dimensions, whereas spending cuts dominate only for the income dimension. Human-development costs are therefore driven primarily by the compression of household disposable income rather than by the direct withdrawal of public spending, except along the income margin itself.

**Keywords:** Fiscal Consolidation, Human Development, Local Projections, Africa.

**JEL classification:** E62, H30, I15, I25, O55.

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<sup>†</sup>CIREM, Université Protestante au Congo. Email: [nephthali.cibangu24@student.upc.ac.cd](mailto:nephthali.cibangu24@student.upc.ac.cd).

<sup>‡</sup>CIREM, Université Protestante au Congo. Email: [mulunda.manasse@upc.ac.cd](mailto:mulunda.manasse@upc.ac.cd).

<sup>§</sup>Boston University and CIREM. Email: [ishara@bu.edu](mailto:ishara@bu.edu).

<sup>¶</sup>*Corresponding author.* Department of Economics, Université Protestante au Congo (UPC), and CIREM UPC. Office: UPC FASE B02, Crossroads of Avenue de la Liberation and Boulevard Triomphal, Lingwala, P.O. Box 4745, Kinshasa 2, DRC. Email: [tsasa.jean-paul@upc.ac.cd](mailto:tsasa.jean-paul@upc.ac.cd).

# 1 Introduction

“Human development is a process of enlarging people’s choices. The most critical of these wide-ranging choices are to live a long and healthy life, to be educated, and to have access to the resources needed for a decent standard of living. Additional choices include political freedom, guaranteed human rights, and personal self-respect. Development enables people to have these choices.”

UNDP (1990, p. 1).

This article examines the effect of discretionary fiscal consolidation episodes on the development process in Sub-Saharan Africa.<sup>1</sup> We use the Human Development Index (HDI) to capture this process.<sup>2</sup> Building on the work of Abdel-Latif et al. (2026a), the paper seeks to determine the extent to which these public-finance re-balancing policies shape the trajectory of the HDI and its three core dimensions, i.e.: health, education, and income. This multidimensional structure makes the HDI particularly well suited for evaluating the broader consequences of fiscal policy. We argue that fiscal consolidation influences not only aggregate demand and public finances but also the public and private investments that sustain human development. For instance, spending cuts may alter the provision of health and education services, while tax increases may compress household disposable income, consumption, and investments in nutrition, schooling, and preventive healthcare. These channels need not operate with the same intensity or over the same horizon across the three dimensions of human development. Consequently, examining the aggregate HDI alone may conceal substantial heterogeneity in the responses of its underlying components.

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<sup>1</sup>Fiscal consolidation refers to a discretionary package of fiscal-policy measures, including expenditure cuts, tax increases, or both, implemented with the primary objective of reducing the fiscal deficit and restoring or strengthening long-term fiscal sustainability, rather than responding to contemporaneous cyclical conditions (Pescatori et al., 2011, 2024; Guajardo, Leigh, and Pescatori, 2014; Alesina, Favero, and Giavazzi, 2019b).

<sup>2</sup>The HDI, introduced by the United Nations Development Programme (UNDP, 1990) combines three complementary dimensions of human development. The health dimension is measured by life expectancy at birth and captures the ability of individuals to enjoy long and healthy lives. The education dimension reflects both the stock and the flow of human capital through expected years of schooling and mean years of schooling. The standard-of-living dimension is proxied by gross national income (GNI) per capita expressed in purchasing power parity terms and transformed logarithmically to account for diminishing marginal returns of income to human well-being. Since the methodological revision introduced in 2010, the HDI has been computed as the geometric mean of normalized indices corresponding to these three dimensions, thereby reducing the degree of substitutability across them and ensuring that poor performance in one dimension cannot be fully offset by exceptional outcomes in another. For further discussions and critical assessments of the HDI, see, among others, Klugman, Rodriguez, and Choi (2011) and Ravallion (2011a,b, 2012).

Thus, our analysis therefore goes beyond the overall index and estimates separately the dynamic effects of fiscal consolidation on the health, education, and income sub-indices. This decomposition enables us to identify the specific margins through which fiscal adjustment affects human development and to assess whether the composition of consolidation, i.e., tax-based versus expenditure-based, generates distinct welfare consequences across different dimensions of human well-being.

Although the literature on fiscal consolidation has expanded considerably over the past three decades, it has remained primarily concerned with aggregate macroeconomic outcomes, including economic growth, fiscal balances, public debt dynamics, private investment, consumption, labor-market performance, and fiscal multipliers (Giavazzi and Pagano 1990; Alesina and Ardagna 2010; Auerbach and Gorodnichenko 2012; Guajardo, Leigh, and Pescatori 2014; Fatás and Summers 2018; Alesina, Favero, and Giavazzi 2019a; Ando et al. 2025). Two main findings emerge from this debate. First, spending-based fiscal consolidation is generally less costly for growth, and sometimes not even recessionary, than those relying on tax increases, as shown by Alesina et al. (2018), as well as by Alesina, Favero, and Giavazzi (2019b). Second, the study of 25 international experiences conducted by Okwuokei (2014) confirms that expenditure-based adjustments, particularly those targeting transfers and the public wage bill, are the most effective and the most durable, provided that they are embedded in a credible medium-term fiscal framework and benefit from political support and a favorable external environment.

This emphasis reflects a long tradition in macroeconomics of assessing stabilization policies through aggregate performance indicators. Much less attention has been devoted to the broader implications of fiscal consolidation for human welfare and human development. Our paper complements this literature by assessing how discretionary fiscal consolidation episodes affect the development process and by examining whether these effects differ according to the composition of fiscal adjustment. In developing economies, where access to essential public services remains uneven and the accumulation of human capital is constrained by limited fiscal capacity, informal economy and persistent infrastructure gaps (see e.g. Calderón and Servén 2010), fiscal adjustment may affect welfare through channels that are only imperfectly captured by GDP dynamics.

This issue is particularly relevant in Sub-Saharan Africa, where governments simultaneously confront narrow tax bases, elevated public debt, recurrent external shocks, and an inadequate supply of infrastructure services (see e.g. Collier and

Gunning 1999, Calderón and Servén 2010, Tagem and Morrissey 2023). These structural constraints considerably narrow fiscal space, forcing policymakers to balance the objective of restoring fiscal sustainability against the need to preserve investments in human capital and long-run development. A reduction in public expenditure or an increase in taxation may restore fiscal credibility, yet simultaneously weaken household consumption, reduce access to education and healthcare, and slow the accumulation of productive human capital. Since investments in health and education generate substantial long-run economic returns, the welfare consequences of fiscal consolidation cannot be inferred solely from its short-run effects on output. In this paper, we shift the focus from macroeconomic stabilization to the evolution of human development.

Fiscal consolidation may influence human development through several distinct transmission mechanisms. First, expenditure-based adjustments may reduce public investments in health, education, and social protection, thereby slowing the accumulation of human capital. Second, tax-based consolidations may compress households' disposable income, reducing private expenditures on nutrition, healthcare, and schooling. Third, fiscal contractions may weaken labor-market conditions, lowering employment opportunities and discouraging private investments in education and skills acquisition. Because these transmission mechanisms differ across expenditure-based and tax-based consolidations, the composition of fiscal adjustment is likely to matter as much as its overall size.

Moreover, here, the identification question is then central. Standard indicators such as the structural primary balance, shocks derived from VAR models, or forecast errors do not always make it possible to properly distinguish discretionary fiscal-policy decisions from endogenous variations linked to the business cycle or to fluctuations in commodity prices. These approaches may therefore confound discretionary policy actions with endogenous fiscal responses, leading to biased estimates of the effects of fiscal policy (Ramey and Shapiro, 1998; Ramey, 2011; Romer and Romer, 2010; Guajardo, Leigh, and Pescatori, 2014). To correct this bias, the narrative approach developed by Romer and Romer (2010), and subsequently extended by Pescatori et al. (2011, 2024) for OECD countries and by Carrière-Swallow, David, and Leigh (2021) for Latin America and the Caribbean, makes it possible to identify genuinely exogenous fiscal measures, that is, those taken solely to reduce the deficit and not in response to the economic situation.

In emerging market and developing economies, this literature converges on a me-

dian fiscal multiplier of about 0.4, against nearly 0.8 in advanced economies. This gap is explained notably by the size of the informal sector, the narrowness of tax bases, and the inefficiency of public spending. The recent contribution of Abdel-Latif et al. (2026b) extends this literature to Sub-Saharan Africa by constructing the first narrative dataset of discretionary fiscal consolidation episodes for 14 countries over the period 1990–2024. Using this dataset, the authors show that conventional identification strategies substantially attenuate the estimated output effects of fiscal consolidation.

Our baseline results indicate that a fiscal consolidation equivalent to 1% of GDP gradually reduces the HDI, with adverse effects that persist over several years. Moreover, the different dimensions of human development do not respond uniformly to fiscal contractions. The education sub-index experiences the largest and most persistent deterioration, whereas the health sub-index records the strongest impact response but gradually returns toward its baseline. By contrast, the income sub-index exhibits comparatively smaller and less persistent effects.

A plausible interpretation is that health absorbs primarily a cyclical shock, whereas education is exposed to a structural shock. Adverse effects on health are relatively reversible once fiscal conditions improve and public spending resumes, while educational losses translate into a lasting deterioration in human capital accumulation. Several mechanisms may account for this asymmetry.

First, education is inherently a long-term investment. Fiscal consolidations often entail cuts in education spending, i.e., including school infrastructure, teacher recruitment, scholarships, and learning materials, which generate persistent consequences. A single year of underinvestment cannot easily be recovered, as learning losses, school dropout, and delayed skill acquisition have long-lasting effects on human capital formation. Second, healthcare spending is more closely tied to immediate and essential needs. Emergency care, vaccination campaigns, and treatment of infectious diseases are often politically and socially difficult to curtail for prolonged periods. Consequently, although fiscal consolidations may initially reduce the availability of medicines, medical personnel, or operating resources, governments frequently reallocate resources or restore funding relatively quickly, allowing health outcomes to recover over time. Third, differences in financing structures may reinforce this asymmetry. In many Sub-Saharan African countries, healthcare systems receive substantial support from external donors and international organizations, whereas education relies much more heavily on domestic public resources. Fiscal consolidations there-

fore tend to translate more directly into reductions in education spending than in health expenditures. Fourth, health expenditures are generally more rigid than education expenditures. Hospitals, emergency services, and essential medical personnel cannot easily be scaled back without immediate social and political costs, whereas investments in school infrastructure, teacher hiring, or educational programs can be postponed more readily during periods of fiscal adjustment. Finally, the returns to education materialize only gradually. Interruptions in educational investment today affect future human capital accumulation, labor productivity, and lifetime earnings, generating persistent effects that extend well beyond the consolidation episode itself. In contrast, improvements in health outcomes may occur relatively quickly once healthcare financing is restored.

These mechanisms suggest that fiscal consolidations may leave long-lived scars on human capital through the education channel, even when the adverse effects on health prove largely transitory. This asymmetry highlights the importance of considering not only the aggregate effects of fiscal adjustment, but also its heterogeneous consequences across the different dimensions of human development.

Our paper is related to a growing literature on the consequences of fiscal consolidation for human development. Among the few existing contributions, Agnello et al. (2018) show that fiscal austerity is associated with lower human development, particularly when consolidations rely on expenditure cuts and in developing economies. More recently, Miningou (2023) document that debt-induced fiscal consolidation significantly reduces public expenditure on education, thereby identifying an important channel through which fiscal adjustment may affect long-run development outcomes. We complement and extend this literature by focusing on narratively identified discretionary fiscal consolidation, examining their dynamic effects on the Human Development Index and its constituent dimensions, and distinguishing between tax-based and expenditure-based adjustment episodes.

Our paper differs from and extends this literature in three important respects. First, it provides, the first systematic evidence on the dynamic effects of narratively identified discretionary fiscal consolidation on human development in Sub-Saharan Africa. Second, rather than relying on broad measures of fiscal austerity or focusing on a single component of human development, we examine both the aggregate Human Development Index and its three constituent dimensions, thereby extending the narrative identification approach to a multidimensional measure of welfare. Third, we show that the composition of fiscal adjustment, namely tax-based versus

expenditure-based consolidations, matters not only for macroeconomic performance but also for the evolution of human capabilities, revealing substantial heterogeneity across the different dimensions of human development.

The remainder of the paper is organized as follows. [Section 2](#) describes the data, presents the narrative fiscal-consolidation dataset, and outlines the empirical methodology based on panel local projections. [Section 3](#) reports the main empirical results, examines the dynamic responses of the Human Development Index and its three constituent dimensions, and explores heterogeneity according to the composition of fiscal adjustment. [Section 4](#) discusses the economic mechanisms underlying the empirical results and their policy implications. Finally, [Section 5](#) concludes. [Appendix A](#) provides a detailed description of the dataset used in the paper, including variable definitions, data sources, and descriptive statistics for the panel of 14 SSA economies. [Appendix B](#) presents a step-by-step derivation of the impulse response based on the local projections approach.

## 2 Data and Methodology

### 2.1 Data

We draw on the narrative dataset of Abdel-Latif et al. (2026a), which documents discretionary fiscal adjustment episodes across 14 Sub-Saharan African (SSA) countries over 1990-2024.<sup>3</sup> Whereas the empirical literature has traditionally evaluated fiscal consolidation through its effects on aggregate macroeconomic outcomes, especially real output (Abdel-Latif et al., 2026b), this paper instead examines their implications for human development, a broader measure of economic and social welfare. We therefore replace GDP with the HDI and its three constituent sub-indices as the outcome variables, while retaining a narrative measure of discretionary fiscal consolidation as the regressor of interest. The data come essentially from two sources: human-development outcomes are taken from the Global Data Lab database,<sup>4</sup> and the narrative fiscal-consolidation series, together with the accompanying macroeconomic and fiscal controls, are taken from Abdel-Latif et al. (2026a) database.<sup>5</sup>

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<sup>3</sup>The sample comprises Angola, Cameroon, Côte d’Ivoire, the Democratic Republic of the Congo (DRC), Ethiopia, Ghana, Kenya, Mauritius, Mozambique, Nigeria, Senegal, South Africa, Tanzania and Uganda. The country dimension is keyed on the ISO 3166-1 alpha-3 code; the country-name field is not used for merging because it may contain inconsistent spellings.

<sup>4</sup><https://globaldatalab.org>.

<sup>5</sup><https://www.hanomics.com/fiscal-narrative-data>.

Table 1 reports descriptive statistics for the key variables.

### 2.1.1 Outcome variables: human development

Our outcome variables are the HDI and its health, education and income sub-indices, obtained from the Global Data Lab (Smits and Permanyer, 2019). The Global Data Lab compiles the index following the methodology of the United Nations Development Programme but offers harmonized and temporally consistent coverage, which is well suited to a panel spanning three decades. By construction, the HDI is the geometric mean of three dimension indices, each normalized to the unit interval: a health index based on life expectancy at birth, an education index based on expected and mean years of schooling, and an income index based on the logarithm of gross national income per capita.<sup>6</sup>

There is substantial variation in human development across countries and over time. Over the full panel the HDI averages 0.504 (standard deviation 0.112), ranging from 0.245 to 0.806. The panel-average HDI rose markedly over the period, from 0.427 in 1990 to 0.595 in 2023. Cross-country differences are equally pronounced: in 2023 Mauritius records the highest value (0.806) and Mozambique the lowest (0.493); over the full period Mauritius (0.727) and South Africa (0.668) are the most developed economies of the sample, while Mozambique (0.374) and Ethiopia (0.414) are the least developed. Among the three dimensions, the education sub-index is both the lowest on average (0.417) and the most dispersed (standard deviation 0.138, range 0.161–0.779), whereas the health sub-index is the highest on average (0.589). This pattern education being the binding human-development margin is a useful backdrop to the empirical analysis. In the regressions, the level outcomes are transformed into cumulative percentage changes,  $100 \times [\ln y_{t+h} - \ln y_{t-1}]$ , mirroring the treatment of real output in the source study.

### 2.1.2 Fiscal consolidation shocks

Our regressor of interest is a narrative measure of discretionary fiscal consolidation, drawn from Abdel-Latif et al. (2026a) database. The narrative, action-based approach, in the tradition of Romer and Romer (2010) and Pescatori et al. (2011, 2024) identifies legislated tax increases and expenditure cuts that were motivated by

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<sup>6</sup>Because the income sub-index is a monotone transformation of GNI per capita, it is mechanically related to aggregate income; this is relevant when interpreting the income-dimension results and motivates examining the health and education dimensions separately.

deficit-reduction or inherited-debt considerations rather than by the contemporaneous state of the business cycle. This identification is designed precisely to circumvent the endogeneity that plagues conventional cyclically-adjusted measures, since fiscal actions taken in response to current output movements would otherwise contaminate the estimated effect. The aggregate consolidation shock (**total**, in percent of HDI) is the sum of its tax-based (**tax**) and expenditure-based (**spend**) components,  $\text{total} \equiv \text{tax} + \text{spend}$ , which allows us to study the composition of adjustment separately.

Consolidation is, as expected, an episodic phenomenon. Of the 481 country-years for which the series is available, 72 record a positive consolidation. The average size of an adjustment, conditional on action being taken, is 0.95 percent of HDI (an unconditional mean of 0.14 percent). The largest single-year consolidation in the sample, 5.1 percent of HDI, is recorded for Côte d’Ivoire in 1994, the year of the CFA-franc devaluation and is split between a tax-based component of 3.1 and an expenditure-based component of 2.0 percent of GDP.

### 2.1.3 Macroeconomic and fiscal controls

The empirical specification includes a standard set of macroeconomic and fiscal controls, all obtained from Abdel-Latif et al. (2026a) database, which compiles them from the IMF World Economic Outlook and related sources. Gross general-government debt (in percent of GDP) averages 52.6 percent and is highly dispersed (standard deviation 28.0), reaching 183.1 percent for Uganda in 1991; the series is available for 405 country-years and is not reported for every country (notably the DRC). The general-government primary balance averages  $-0.75$  percent of GDP. Real GDP growth, already expressed in percent, averages 4.3 percent, with a minimum of  $-15.7$  percent (Mauritius in 2020, reflecting the pandemic collapse of tourism) and a maximum of 13.6 percent. Consumer-price inflation has a median of 7.1 percent but a long right tail driven by genuine hyperinflation episodes, most strikingly 23,773 percent for the DRC in 1994 so that the median is far more representative than the mean. The remaining controls are the change in the (commodity) terms of trade, the change in mean temperature, gross official development assistance relative to GDP, an indicator for an IMF-supported program, and the revision to the WEO real-GDP-growth forecast, the last of which we use to assess the orthogonality of the narrative shock to expected output movements. The primary balance, total expenditure and nominal GDP are additionally used to construct the cyclically-adjusted primary balance employed in the instrumental-variables specification.

Two series carry data-quality caveats. The official-development-assistance variable mixes units across observations fractions, percentages and a handful of raw dollar levels for a few early-1990s observations, and we therefore clean it before use and exclude it from the descriptive correlations. Inflation, while genuine, is so heavy-tailed that we summarize it by its median and treat the hyperinflation observations with care in any analysis based on Pearson moments.

#### 2.1.4 Descriptive statistics

**Table 1** summarizes the key variables. The human-development indices occupy the unit interval; the consolidation series are expressed in percent of GDP and are zero in the large majority of country-years, consistent with the episodic nature of discretionary adjustment; and the macro-fiscal controls display the wide dispersion characteristic of a heterogeneous panel of SSA economies.

Table 1: Descriptive statistics. Panel of 14 Sub-Saharan African countries, 1990–2024.

| Variable                                    | Obs. | Mean   | Std. Dev. | Min    | Max      |
|---------------------------------------------|------|--------|-----------|--------|----------|
| <i>Human development</i> (index, $[0, 1]$ ) |      |        |           |        |          |
| Human Development Index                     | 457  | 0.504  | 0.112     | 0.245  | 0.806    |
| Health sub-index                            | 457  | 0.589  | 0.106     | 0.374  | 0.847    |
| Education sub-index                         | 457  | 0.417  | 0.138     | 0.161  | 0.779    |
| Income sub-index                            | 457  | 0.537  | 0.126     | 0.237  | 0.847    |
| <i>Fiscal consolidation</i> (% of GDP)      |      |        |           |        |          |
| Consolidation (total)                       | 481  | 0.142  | 0.474     | 0.000  | 5.100    |
| Tax-based component                         | 481  | 0.081  | 0.280     | 0.000  | 3.100    |
| Spending-based component                    | 481  | 0.062  | 0.253     | 0.000  | 2.000    |
| <i>Macroeconomic and fiscal controls</i>    |      |        |           |        |          |
| Public debt (% of GDP)                      | 405  | 52.62  | 27.95     | 2.14   | 183.15   |
| Primary balance (% of GDP)                  | 429  | −0.75  | 3.37      | −13.68 | 29.01    |
| Real GDP growth (%)                         | 476  | 4.29   | 3.91      | −15.72 | 13.63    |
| Inflation (%)                               | 471  | 105.90 | 1143.29   | −8.24  | 23773.10 |

Note: Time series for HDI is from the Global Data Lab. The consolidation series and the macro-fiscal controls are from the Abdel-Latif et al. (2026a)’s fiscal-narrative database. The consolidation series are zero in most country-years, reflecting the episodic nature of discretionary adjustment. Inflation is heavy-tailed owing to hyperinflation episodes (e.g. the DRC in 1994); its median is 7.1 percent.

## 2.2 Methodology

To assess the dynamic effects of fiscal consolidation on human development, we follow Abdel-Latif et al. (2026b) and estimate impulse response functions using the local projections (LP) methodology proposed by Jordà (2005). Unlike vector autoregressions (VARs), local projections estimate the response at each forecast horizon directly, thereby avoiding the need to specify and estimate the entire underlying multivariate dynamic system. This approach is particularly attractive when the data-generating process is unknown or potentially misspecified, as it is more robust to dynamic misspecification while remaining straightforward to extend to nonlinear settings and state-dependent analyses.

Let  $i$  index countries and  $t$  denote years,  $HDI_{i,t}$  denote the Human Development Index, or alternatively one of its three constituent dimensions (i.e., health, education, and income), and let  $\Delta FC_{i,t}$  denote a narrative fiscal consolidation shock, expressed as a percentage of HDI. For each projection horizon  $h \in \{0, 1, \dots, H\}$ , the baseline linear local projection model is given by:

$$HDI_{i,t+h} - HDI_{i,t-1} = \mu_{i,h} + \tau_{t,h} + \beta_h \sum_{j=0}^h \Delta FC_{i,t+j} + \Omega'_h X_{i,t} + \varepsilon_{i,t+h}. \quad (1)$$

where  $\mu_{i,h}$  denotes horizon-specific country fixed effects,  $\tau_{t,h}$  denotes horizon-specific year fixed effects  $X_{i,t}$  is a vector of controls, and  $\varepsilon_{i,t+h}$  is the error term. The coefficient  $\beta_h$  measures the average response of human development to fiscal consolidation at horizon  $h$ . Formally:

$$\beta_h = \frac{\partial (HDI_{i,t+h} - HDI_{i,t-1})}{\partial (\sum_{j=0}^h \Delta FC_{i,t+j})}. \quad (2)$$

Thus, the linear model assumes that the effect of fiscal consolidation on human development is homogeneous across countries and states of the economy:

$$IRF_h = \beta_h. \quad (3)$$

This assumption may be restrictive. The effect of fiscal consolidation on the HDI may depend on the economic environment. For instance, a fiscal adjustment may have more adverse effects on human development during periods of weak economic activity, limited fiscal space, or low external development assistance. Conversely, the same consolidation shock may be less damaging when economic conditions are stronger or when development aid buffers the adjustment. To allow the response to

depend on the state of the economy, we replace the constant coefficient  $\beta_h$  with a state-dependent coefficient:

$$\beta_h \longrightarrow \beta_h(Z_{i,t}), \quad (4)$$

where  $Z_{i,t}$  denotes a normalized state variable that captures the prevailing macroeconomic environment through business cycle conditions, fiscal stance, external financing conditions, and macroeconomic stability. Thus the state-dependent local projection model can first be written as:

$$HDI_{i,t+h} - HDI_{i,t-1} = \mu_{i,h} + \tau_{t,h} + \Omega'_h X_{i,t} + \beta_h(Z_{i,t}) \sum_{j=0}^h \Delta FC_{i,t+j} + \varepsilon_{i,t+h}. \quad (5)$$

We assume that the response of human development to fiscal consolidation can vary smoothly between two regimes. Let  $\beta_{h,L}$  denote the response in a low state, and let  $\beta_{h,H}$  denote the response in a high state. The state-dependent coefficient is defined as a weighted average:

$$\beta_h(Z_{i,t}) = F(Z_{i,t})\beta_{h,L} + [1 - F(Z_{i,t})]\beta_{h,H}. \quad (6)$$

The transition function  $F(Z_{i,t})$  is specified as:

$$F(Z_{i,t}) = \frac{\exp(-\gamma Z_{i,t})}{1 + \exp(-\gamma Z_{i,t})}, \quad \gamma > 0. \quad (7)$$

The logistic function determines how much weight is assigned to each regime. It satisfies:

$$0 < F(Z_{i,t}) < 1. \quad (8)$$

When  $Z_{i,t} \rightarrow -\infty$ , we have:

$$F(Z_{i,t}) \rightarrow 1, \quad (9)$$

so that

$$\beta_h(Z_{i,t}) \rightarrow \beta_{h,L}. \quad (10)$$

When  $Z_{i,t} \rightarrow +\infty$ , we have:

$$F(Z_{i,t}) \rightarrow 0, \quad (11)$$

so that

$$\beta_h(Z_{i,t}) \rightarrow \beta_{h,H}. \quad (12)$$

Therefore, the impulse response of the HDI to fiscal consolidation is no longer constant. It is given by:

$$IRF_h(Z_{i,t}) = F(Z_{i,t})\beta_{h,L} + [1 - F(Z_{i,t})]\beta_{h,H}. \quad (13)$$

Substituting equation (6) into equation (5) gives:

$$\begin{aligned}
HDI_{i,t+h} - HDI_{i,t-1} = & \mu_{i,h} + \tau_{t,h} + \Omega'_h X_{i,t} \\
& + [F(Z_{i,t})\beta_{h,L} + (1 - F(Z_{i,t}))\beta_{h,H}] \sum_{j=0}^h \Delta FC_{i,t+j} + \varepsilon_{i,t+h}.
\end{aligned} \tag{14}$$

Equivalently, expanding the interaction terms, we obtain the following estimable form:

$$\begin{aligned}
HDI_{i,t+h} - HDI_{i,t-1} = & \mu_{i,h} + \tau_{t,h} + \Omega'_h X_{i,t} \\
& + \beta_{h,L} \left[ F(Z_{i,t}) \sum_{j=0}^h \Delta FC_{i,t+j} \right] \\
& + \beta_{h,H} \left[ (1 - F(Z_{i,t})) \sum_{j=0}^h \Delta FC_{i,t+j} \right] + \varepsilon_{i,t+h}.
\end{aligned} \tag{15}$$

This specification suggests that the fiscal consolidation shock is interacted with the state weights  $F(Z_{i,t})$  and  $1 - F(Z_{i,t})$ . The coefficient  $\beta_{h,L}$  captures the response of the HDI to fiscal consolidation in a low state, while  $\beta_{h,H}$  captures the response in a high state.

The state variable is normalized as follows:

$$Z_{i,t} = \frac{s_{i,t} - \bar{s}_i}{\sigma(s_i)}, \tag{16}$$

where  $s_{i,t}$  denotes the raw state variable,  $\bar{s}_i$  is its country-specific mean, and  $\sigma(s_i)$  is its country-specific standard deviation. Hence:

$$E(Z_{i,t}) = 0, \quad Var(Z_{i,t}) = 1. \tag{17}$$

The smoothing parameter  $\gamma$  controls the speed of transition between regimes. A small value of  $\gamma$  implies a gradual transition, whereas a large value makes the model closer to a threshold specification:

$$\gamma \rightarrow \infty \quad \Rightarrow \quad F(Z_{i,t}) \approx \mathbb{1}\{Z_{i,t} < 0\}. \tag{18}$$

Thus, the smooth-transition specification avoids imposing an abrupt regime switch and allows the effect of fiscal consolidation on human development to vary continuously with macroeconomic conditions.

For a given shock size, for example a fiscal consolidation of one percent of HDI, the state-dependent response of the HDI at horizon  $h$  is:

$$\Delta HDI_h(Z_{i,t}) = IRF_h(Z_{i,t}) \times 1 = F(Z_{i,t})\beta_{h,L} + [1 - F(Z_{i,t})]\beta_{h,H}. \quad (19)$$

The difference between the two regimes is given by:

$$\Delta_h^{L-H} = \beta_{h,L} - \beta_{h,H}. \quad (20)$$

As result, a statistically significant value of  $\Delta_h^{L-H}$  would indicate that the effect of fiscal consolidation on human development differs depending on the state of the economy.

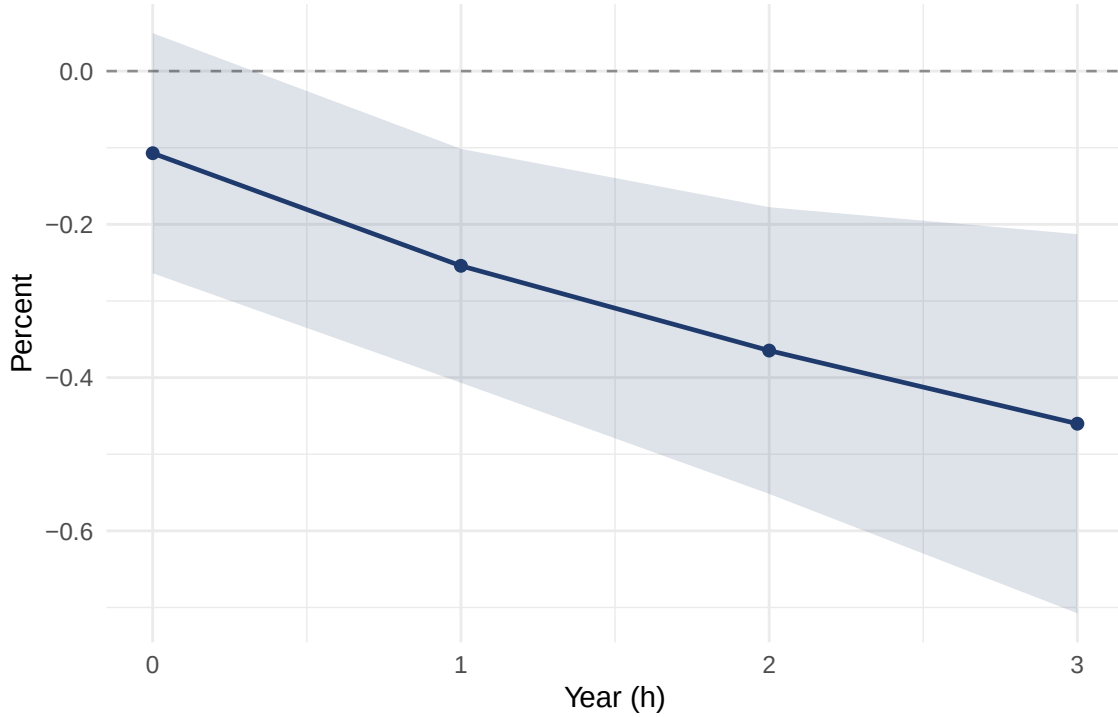
Additional details are provided in the appendices. [Appendix A](#) reports the variable definitions, data sources, and descriptive statistics, while [Appendix B](#) provides a step-by-step derivation of the impulse response based on the local projections approach.

### 3 Results

We are now ready to examine the effects of fiscal consolidation on human development and its constituent components. We estimate panel local projections to trace the dynamic responses of the Human Development Index (HDI) and its three sub-indices, i.e., health, education, and income, following consolidation episodes.

*Aggregate response* ([Figure 1](#)). A discretionary consolidation of 1% of GDP triggers a negative and monotonically deepening response of the Human Development Index. The effect is small but already negative on impact (about -0.1% relative to baseline at  $h = 0$ ), and it accumulates steadily to roughly -0.25% at  $h = 1$ , -0.37% at  $h = 2$  and -0.46% at  $h = 3$ . Two features are worth emphasizing. First, the response is cumulative rather than instantaneous: human development does not jump on impact and then revert, as a transitory demand shock would; instead it drifts further below baseline at each successive horizon, which is the signature of a persistent, stock-like adjustment in living standards rather than a one-off flow loss. Second, the confidence band widens with the horizon: the effect is most precisely estimated at the short-to-medium horizons ( $h = 1, 2$ ), so the three-year point estimate, although larger in magnitude, is estimated with less precision. The headline result is therefore best stated as a statistically robust deterioration over a one-to-two-year window that

Figure 1: Effect of 1% of GDP fiscal consolidation on HDI



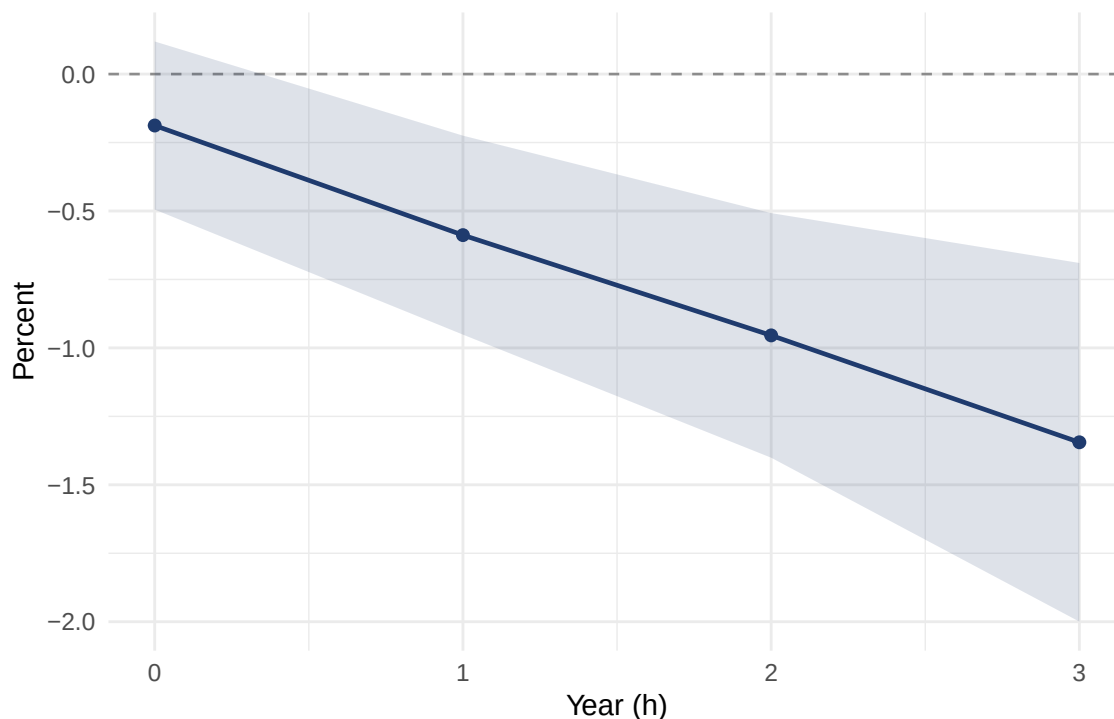
Note: **Figure 1** reports the impulse response of the Human Development Index (HDI) to a narratively identified fiscal consolidation equivalent to 1% of GDP, estimated using panel local projections. The solid line represents the estimated response, while the shaded area denotes the 90% confidence interval. The response is negative on impact and becomes progressively larger over subsequent horizons, reaching approximately  $-0.46\%$  after three years. The results indicate a cumulative and persistent deterioration in human development rather than a temporary decline, although the confidence intervals widen at longer horizons, reflecting greater estimation uncertainty

continues to build, rather than as a sharply significant long-horizon level.

*Heterogeneity across dimensions.* Decomposing the HDI into its sub-indices shows that the aggregate response is driven almost entirely by the education dimension. In **Figure 2**, Education exhibits by far the largest and most persistent losses; on the order of  $-0.2\%$  on impact, deepening monotonically to roughly  $-1.3\%$  to  $-1.4\%$  by  $h = 3$ , with a confidence band that remains below zero throughout, making it the only component whose deterioration is unambiguously significant and persistent across

all horizons. This identifies education as the binding human-development margin, consistent with the descriptive evidence that it is both the lowest and the most dispersed sub-index in the sample.

Figure 2: Effect of a 1% of GDP fiscal consolidation on the Education sub-index

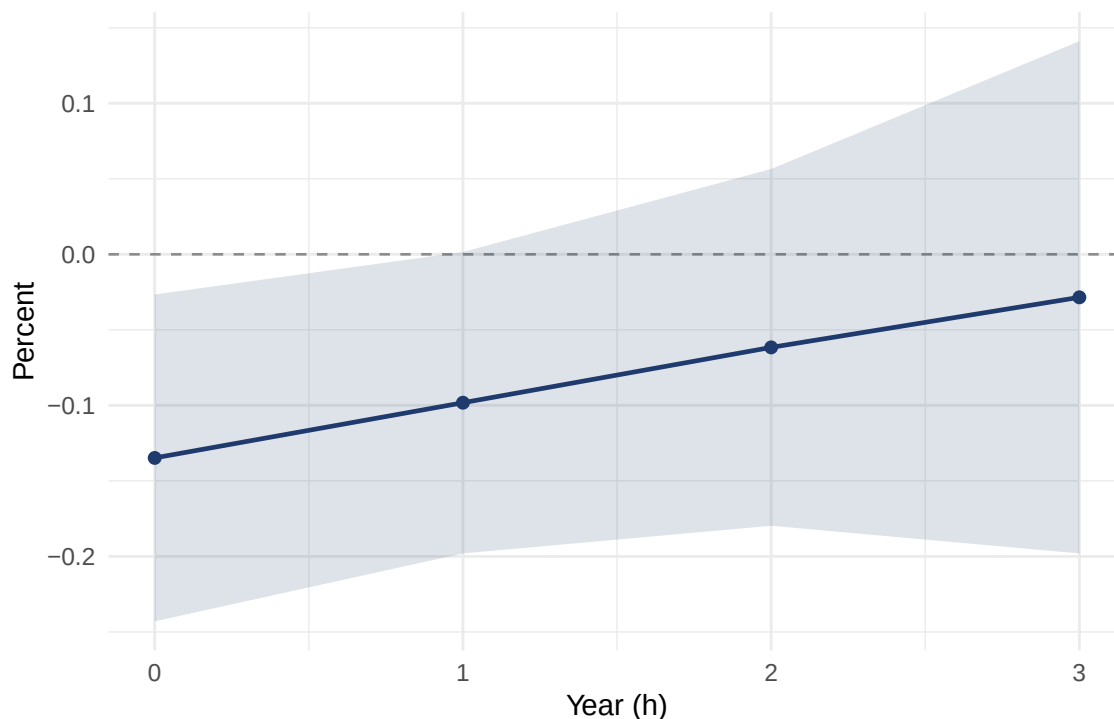


Note: **Figure 2** reports the impulse response of the education component of the Human Development Index (HDI) to a narratively identified fiscal consolidation equivalent to 1% of GDP, estimated using panel local projections. The solid line represents the estimated response, while the shaded area denotes the 90% confidence interval. The education sub-index exhibits the largest and most persistent decline among all HDI components. The response is already negative on impact (approximately  $-0.2\%$ ), continues to deteriorate over time, and reaches about  $-1.4\%$  after three years. The confidence interval remains below zero throughout the projection horizon, indicating a statistically significant and persistent adverse effect of fiscal consolidation on educational outcomes.

By contrast, in **Figure 3**, the health sub-index shows a significant contraction concentrated on impact (about  $-0.14\%$  at  $h = 0$ ) that subsequently recovers toward zero and loses significance by the medium horizon, an effect that is real but transitory. The income sub-index displays only a shallow, hump-shaped dip (trough of about

-0.15% to -0.17% around  $h = 1-2$ ) whose band straddles zero at every horizon, so its response is economically minor and statistically weak; this is expected, since the income sub-index is a monotone transformation of GNI per capita and essentially mirrors the modest output contraction documented in the source study. The policy implication is that the welfare cost of consolidation operates predominantly through human-capital accumulation (schooling), not through the income channel that dominates conventional multiplier analyses.

Figure 3: Effect of a 1% of GDP fiscal consolidation on the Health sub-index



Note: **Figure 3** reports the impulse response of the health component of the Human Development Index (HDI) to a narratively identified fiscal consolidation equivalent to 1% of GDP, estimated using panel local projections. The solid line represents the estimated response, while the shaded area denotes the 90% confidence interval. The health sub-index records a statistically significant decline on impact (approximately  $-0.14\%$ ), but the effect gradually fades over time and becomes statistically insignificant beyond the short run. Unlike the education dimension, the adverse effect on health is therefore transitory rather than persistent.

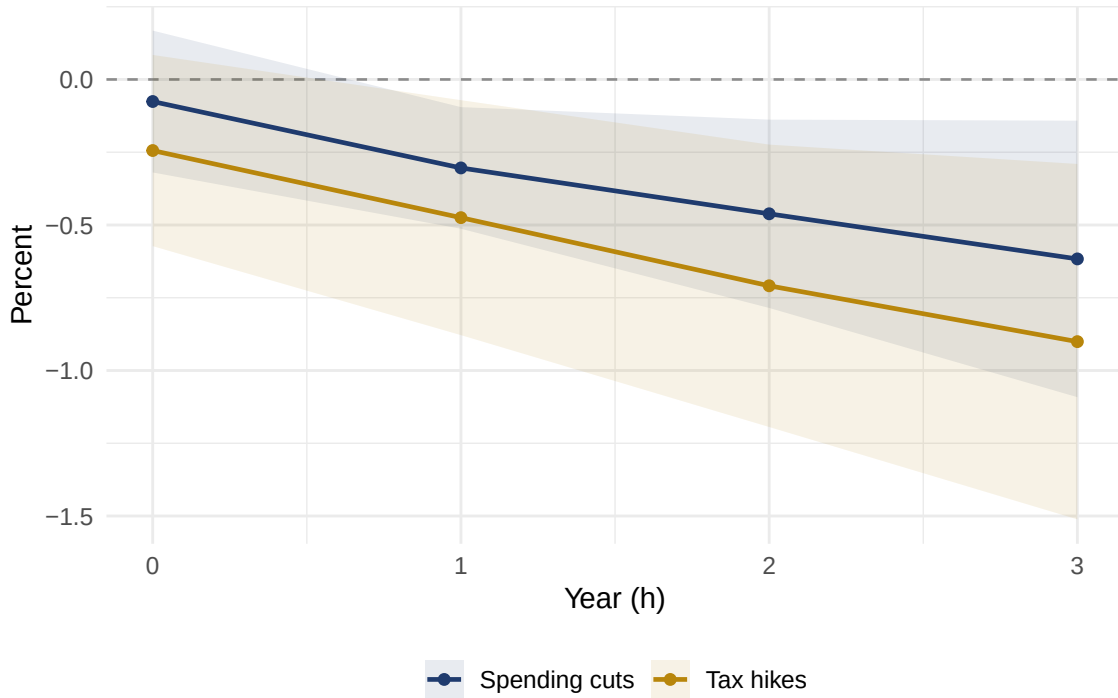
*Composition of the adjustment: tax hikes vs. spending cuts.* The decomposition

by fiscal instrument reveals substantial heterogeneity across the different dimensions of human development. For the aggregate Human Development Index (Figure 4), tax-based consolidations generate larger and more persistent declines than expenditure-based consolidations, suggesting that revenue-based adjustments impose greater overall human-development costs. The health dimension (Figure 5) displays a comparable ordering, with tax-based consolidations generally associated with larger declines than expenditure-based adjustments. However, spending-based fiscal consolidations remain statistically insignificant from zero throughout the projection horizon. A similar pattern emerges for education (Figure 6), where both tax-based and expenditure-based consolidations generate large and progressively deepening declines in the education sub-index. Tax-based consolidations produce consistently larger losses than expenditure-based consolidations throughout the projection horizon. These findings indicate that educational outcomes deteriorate regardless of the adjustment strategy, although the adverse effects are systematically more pronounced under tax-based fiscal consolidations. A different picture emerges for the income dimension (Figure 7). Expenditure-based consolidations generate a larger and more persistent decline in the income sub-index, with the maximum effect occurring approximately two years after the fiscal shock. By contrast, tax-based consolidations produce only small responses, which are initially slightly positive and remain statistically insignificant from zero throughout the projection horizon. This result suggests that spending cuts affect the income dimension more directly, most likely through their immediate impact on aggregate demand and economic activity, whereas tax increases exert only limited additional effects on this particular component of human development. Our findings show that the composition of fiscal adjustment matters considerably. Revenue-based consolidations are generally more detrimental to the aggregate HDI and to its health and education dimensions, whereas expenditure-based consolidations have their strongest adverse effects on the income dimension.

## 4 Underlying Mechanisms

The negative response of the HDI is consistent with the short-run contractionary effects of fiscal adjustment emphasized by the Keynesian multiplier literature (Giovannini and Pagano, 1990; Guajardo, Leigh, and Pescatori, 2014). The local-projection dynamics show that this welfare loss is *cumulative and persistent* rather than instantaneous: the index drifts further below baseline at each horizon. This is intelligible once one recognizes that the HDI aggregates largely *stock* variables, educational attainment and health capital, that respond to a sustained reduction in the resources that feed them, whether public or private (Anand and Ravallion, 1993; Sen, 1999).

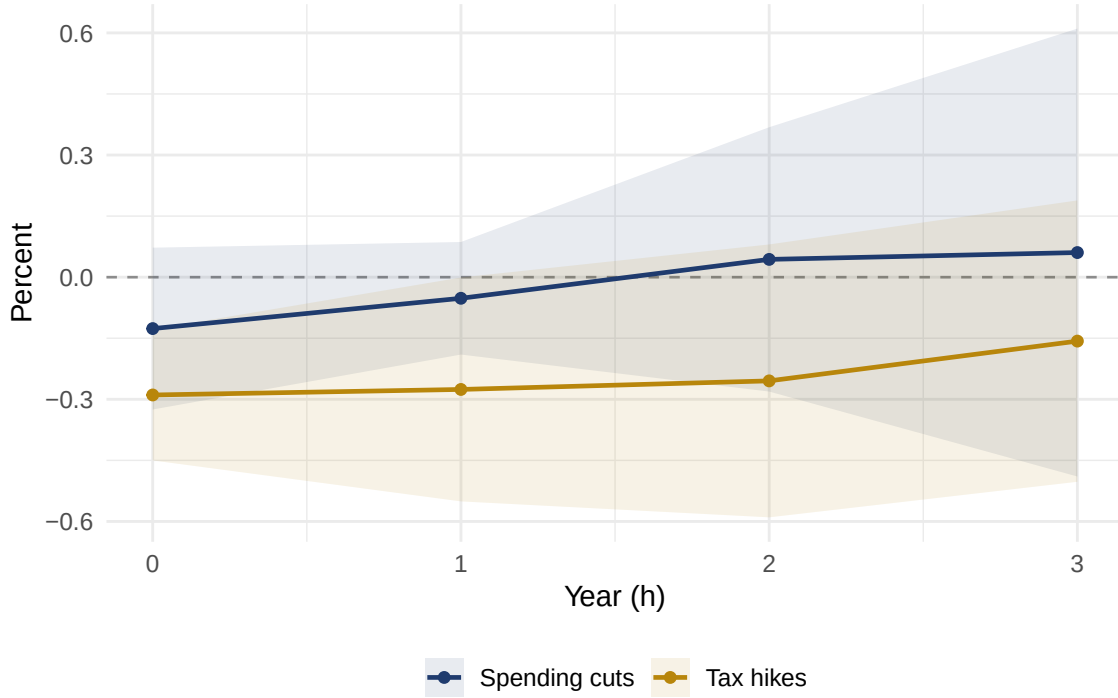
Figure 4: Effect of a 1% of GDP tax hike and spending cut on HDI



Note: [Figure 4](#) reports the impulse responses of the Human Development Index (HDI) to tax-based and expenditure-based fiscal consolidations, each equivalent to 1% of GDP, estimated using panel local projections. Solid lines denote the estimated responses and shaded areas the corresponding 90% confidence intervals. Tax-based consolidations generate larger and more persistent declines in the HDI than expenditure-based consolidations across virtually all horizons, indicating that revenue-based adjustments impose greater human-development costs.

The composition asymmetry is the central result, and its direction is economically coherent. For the aggregate HDI and for the health and education dimensions, *tax-based* consolidations are the more damaging instrument; only along the *income* dimension do expenditure cuts dominate. The mechanism is the channel through which each instrument operates. In low-income SSA economies, health and education outcomes depend heavily on *household* resources, out-of-pocket health payments and private financing of schooling (fees, materials, nutrition) are large shares of total financing. Tax increases compress disposable income and therefore directly curtail this private demand for human-capital services, a channel consistent with the finding of

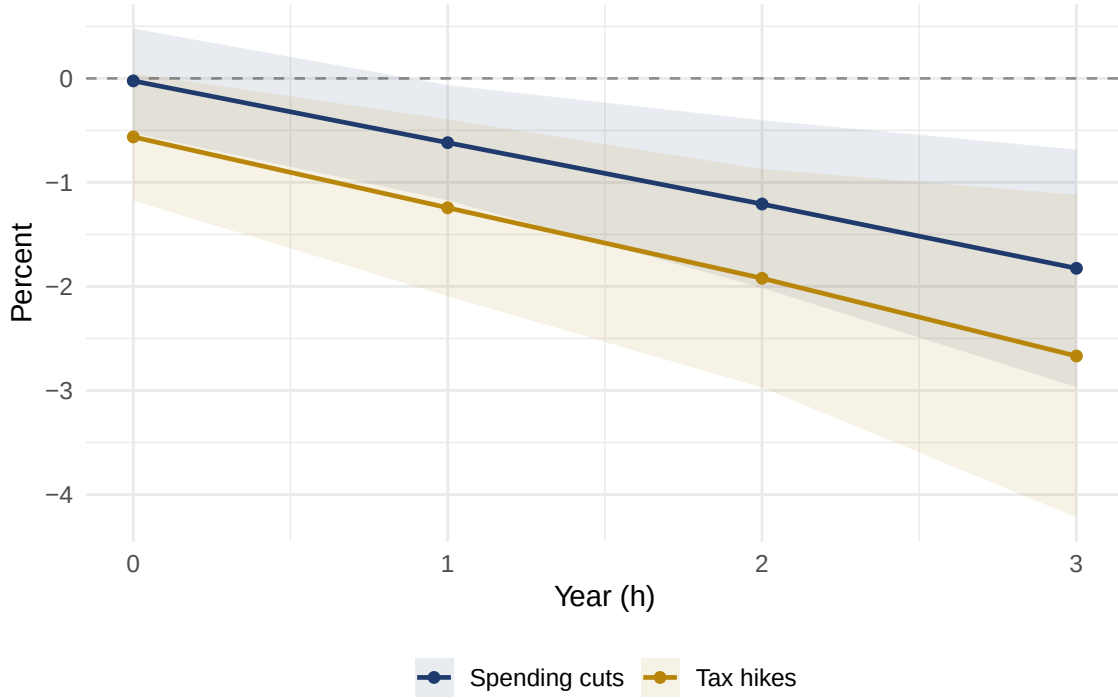
Figure 5: Effect of a 1% of GDP tax hike and spending cut on Health index



Note: **Figure 5** reports the impulse responses of the health component of the Human Development Index (HDI) to tax-based and expenditure-based fiscal consolidations equivalent to 1% of GDP. Tax-based consolidations produce larger declines than expenditure-based consolidations, although the confidence intervals overlap substantially. Notice the impulse responses of the health component of the Human Development Index (HDI) to expenditure-based fiscal consolidations are statistically insignificant from zero throughout the projection horizon.

Anand and Ravallion (1993) that private incomes, not only public services, are decisive for human development in poor countries. Expenditure cuts, by contrast, reduce *aggregate demand* directly, so their incidence is concentrated on the income/output margin, which is precisely where they are found to dominate. This reading also reconciles our evidence with the macro-fiscal literature, which finds expenditure-based consolidations *less* costly for output and more likely to succeed (Alesina and Ardagna, 2010; Alesina et al., 2018; Alesina, Favero, and Giavazzi, 2019b; Okwuokei, 2014): spending cuts spare household disposable income and hence the human-capital dimensions, even as they weigh on measured income.

Figure 6: Effect of a 1% of GDP tax hike and spending cut on Education index

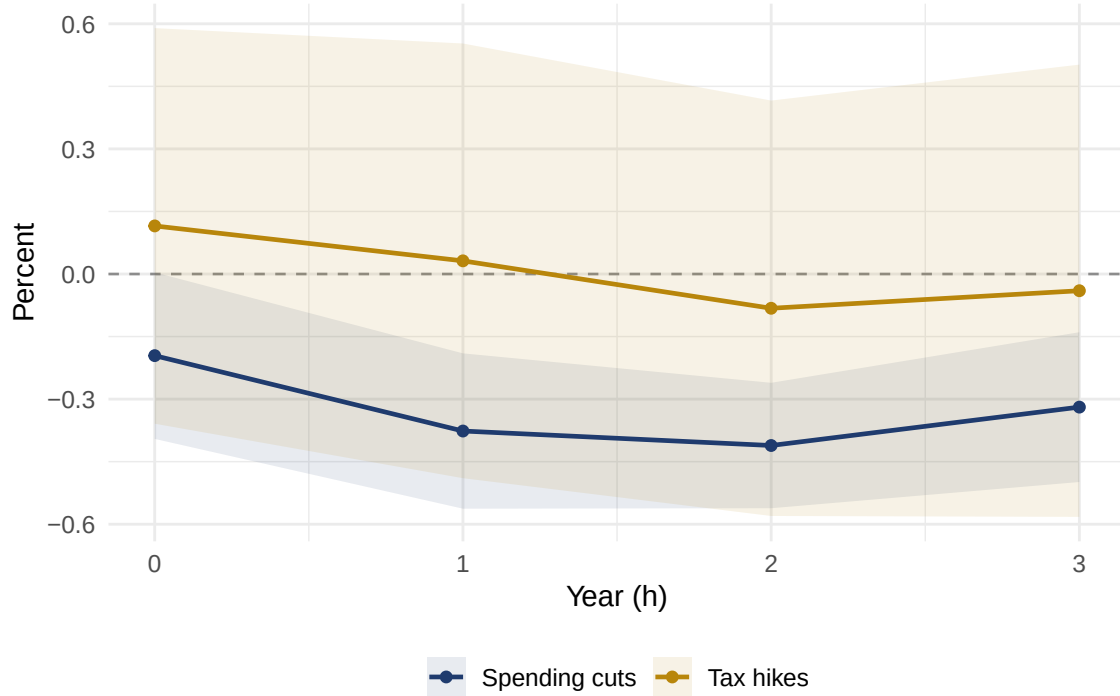


Note: [Figure 6](#) reports the impulse responses of the education component of the Human Development Index (HDI) to tax-based and expenditure-based fiscal consolidations equivalent to 1% of GDP. Both adjustment instruments generate substantial and persistent declines in educational outcomes, but the response is consistently larger under tax-based consolidations. These results suggest that education constitutes the principal channel through which fiscal consolidation affects human development.

Three broad patterns emerge from [Table 2](#). First, the timing of the effect differs sharply across dimensions. The aggregate HDI response is negative but small on impact and deepens over the one-to-two-year window, consistent with a cumulative rather than instantaneous adjustment. The two human-capital sub-indices behave in opposite ways: health contracts significantly on impact but reverts thereafter (a transitory disruption), whereas education shows no impact effect yet becomes significant after about two quarters and remains so, a delayed but persistent deterioration. The income sub-index is not significant at any horizon.

Second, education exhibits the largest response in absolute value, followed by

Figure 7: Effect of a 1% of GDP tax hike and spending cut on the Income Sub-index



Note: **Figure 7** reports the impulse responses of the income component of the Human Development Index (HDI) to tax-based and expenditure-based fiscal consolidations, each equivalent to 1% of GDP, estimated using panel local projections. Solid lines represent the estimated responses and the shaded areas the corresponding 90% confidence intervals. Expenditure-based consolidations generate a larger and more persistent decline in the income sub-index, with the maximum effect occurring around two years after the shock. By contrast, tax-based consolidations generate only small responses, which are initially slightly positive and remain statistically insignificant from zero throughout the projection horizon.

health, whereas the income dimension displays the smallest response. Education is by far the most sensitive margin, which suggests human-capital accumulation, not contemporaneous income, as the channel through which consolidation depresses human development. The income dimension, mechanically tied to GNI per capita, merely inherits the modest output contraction and so registers the weakest response. Third, the composition of the adjustment matters, and its direction is dimension-specific. For the aggregate HDI and for the health and education dimensions, tax-based con-

Table 2: Responses of the HDI and its components to a 1% of GDP fiscal consolidation

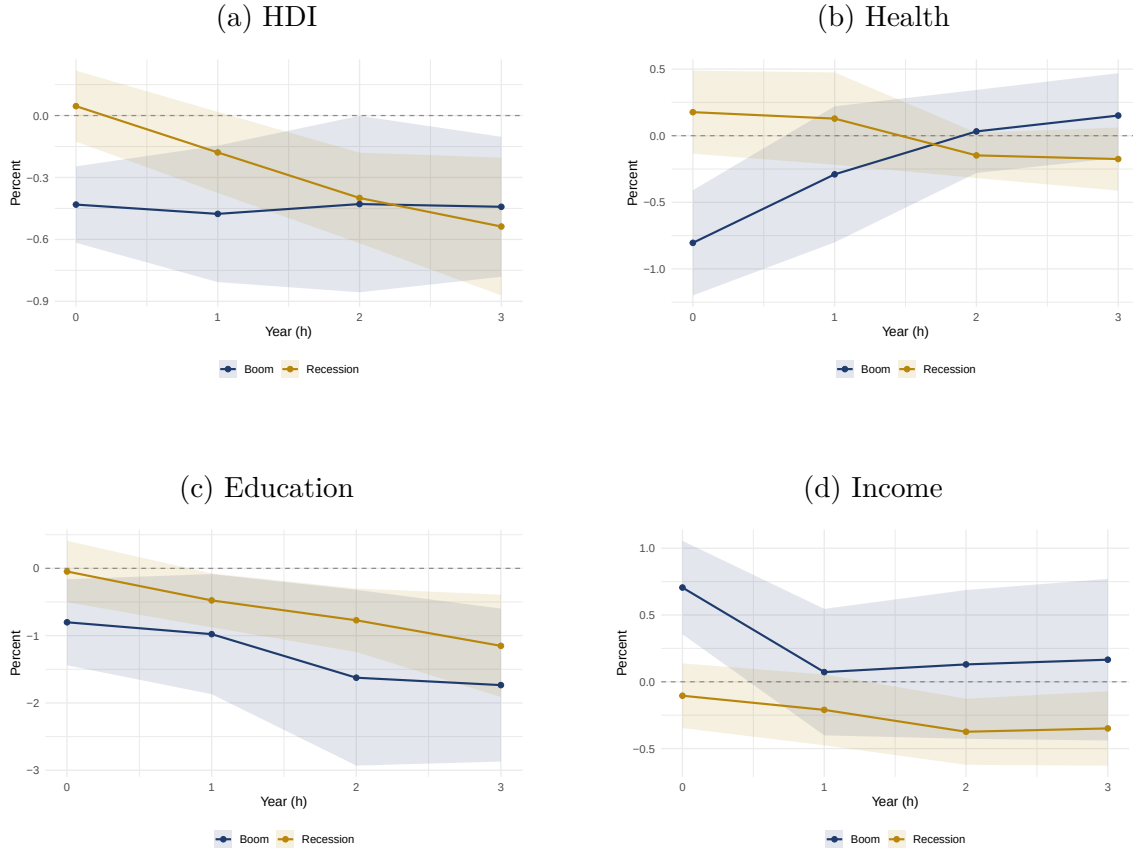
| Component | Impact at $h = 0$       | Becomes significant                 | More severe instrument                      |
|-----------|-------------------------|-------------------------------------|---------------------------------------------|
| HDI       | Negative (small)        | $h = 1-2$ , deepening               | Tax hike > spending cut                     |
| Health    | Significant, transitory | $h = 0$ , fades thereafter          | Tax hike > spending cut (overlapping bands) |
| Education | Not significant         | After $\sim 2$ quarters, persistent | Tax hike > spending cut                     |
| Income    | Not significant         | —                                   | Spending cut > tax hike                     |

Note: Responses are reported as cumulative percentage deviations from baseline,  $100 \times (\ln(y_{t+h}) - \ln(y_{t-1}))$ , estimated using panel local projections over horizons  $h \in \{0, 1, 2, 3\}$ . Peak-response magnitudes are largest for education, followed by health, and smallest for income. The “more severe instrument” column compares the estimated impulse responses associated with tax-based and expenditure-based fiscal consolidation reported in Figures 4, 5, 6 and 7. Tax-based consolidations are more damaging for the aggregate HDI and for its health and education dimensions, whereas expenditure-based consolidations have larger adverse effects on the income dimension.

solidations are the more damaging instrument; only for income do spending cuts dominate. The two instruments operate through different channels: tax increases compress household disposable income and thus the private financing of schooling and health, harming the human-capital dimensions, while expenditure cuts act directly on aggregate demand and therefore bite hardest on the income/output margin. This also reconciles the result with the macro-fiscal literature in which spending-based consolidations are the less output-costly instrument.

Moreover, responses to narrative fiscal consolidation may vary across the business cycle. Figure 8 presents the estimated nonlinear effects of fiscal consolidation on HDI and its components across different phases of the business cycle. The Figure 8a indicates that fiscal consolidation has a negative effect on HDI during economic expansions, while the response during recessions is statistically insignificant at short horizons and turns negative and significant only at longer horizons (after  $h = 1$ ). The same pattern holds for the education sub-index (cf. Figure 8c), which (consistent with the baseline results) is the component that drives the aggregate HDI response.

Figure 8: Effect of a 1% of GDP fiscal consolidation on HDI and its components  
According to the Business Cycle



Fiscal consolidation has a negative effect on the health sub-index during expansions (cf. Figure 8b), but the effect is transitory and fades by about  $h = 1$ ; during recessions the response is insignificant. On Figure (8d), the income sub-index shows a positive response to consolidation during expansions that fades before  $h = 1$ , and an insignificant response during recessions.

These findings suggest that the design of fiscal consolidation matters at least as much as its magnitude. In the Sub-Saharan African countries considered here, consolidation episodes relying more heavily on tax increases are associated with larger and more persistent declines in human development than comparable expenditure-based adjustments. Because investments in health and education generate long-lasting re-

Table 3: State-dependent responses of the HDI and its components to a 1% of GDP fiscal consolidation

| Component | Impact at $h = 0$                            | Becomes significant                                         | Boom                                                                    | Recession                                                                         |
|-----------|----------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| HDI       | Negative (boom); not significant (recession) | $h = 0$ (boom); after $\sim 2$ quarters (recession)         | Negative and persistent throughout the projection horizon.              | Initially insignificant; becomes negative and persistent after $\sim 2$ quarters. |
| Health    | Negative (boom); not significant (recession) | $h = 0$ (boom); remains not significant (recession)         | Negative on impact, with the effect fading after $h = 1$ .              | Statistically insignificant throughout the projection horizon.                    |
| Education | Negative (boom); not significant (recession) | $h = 0$ (boom); after $\sim 2$ quarters (recession)         | Largest and most persistent decline; drives the aggregate HDI response. | Initially insignificant; becomes negative and persistent after $\sim 2$ quarters. |
| Income    | Positive (boom); not significant (recession) | Not significant (boom); after $\sim 3$ quarters (recession) | Small positive response on impact that fades rapidly.                   | Initially insignificant; becomes negative and persistent after $\sim 3$ quarters. |

*Note:* Table 3 summarizes the nonlinear impulse responses estimated using state-dependent panel local projections. Economic states are identified using the business-cycle indicator through the logistic transition function described in Section 2. Results are based on Figure 8. Fiscal consolidations are generally more harmful during economic expansions than during recessions, with education accounting for most of the decline in the aggregate Human Development Index.

turns for productivity, labor-market performance, and long-run economic growth, fiscal gains achieved at the expense of human-capital accumulation may ultimately weaken the foundations of future economic performance and, indirectly, fiscal capacity itself. Fiscal consolidation should therefore be evaluated not only by its ability to reduce fiscal deficits and stabilize public debt, but also by its implications for human development and its constituent components, i.e., health, education, and income. More broadly, our results highlight the importance of the composition of fiscal adjustment. Designing consolidation programs that preserve productive investments in human capital while limiting adverse effects on households' disposable income may help reconcile fiscal sustainability with sustained and inclusive development.

## 5 Conclusion

This paper examined the dynamic effects of discretionary fiscal consolidation on human development in Sub-Saharan Africa. Drawing on the newly constructed narrative dataset of Abdel-Latif, Bechchani, David, and Lemaire (2026b), we combined narratively identified fiscal-consolidation episodes with panel local projections to estimate the dynamic responses of human development and its three core dimensions, i.e., health, education, and income, following exogenous fiscal adjustment episodes.

Our analysis yields three main findings. First, discretionary fiscal consolidation reduces human development in a persistent manner. Rather than disappearing after the initial fiscal shock, the adverse effects accumulate over time, indicating that the costs of fiscal adjustment extend well beyond short-run output losses. Second, the responses are highly heterogeneous across the components of the HDI. Education experiences the largest and most persistent deterioration, whereas health is affected primarily in the short run and the income dimension displays comparatively modest responses. Third, the composition of fiscal adjustment matters. Tax-based consolidations are associated with substantially larger declines in the aggregate HDI and in its health and education dimensions than expenditure-based consolidations, whereas spending cuts have their strongest effects on the income dimension.

Our results carry important policy implications. Fiscal consolidation should not be evaluated solely on the basis of its ability to restore fiscal balances or stabilize public debt. Its composition and its consequences for human development deserve equal attention, particularly in low-income economies where investments in health and education remain central to long-run productivity growth and inclusive development. Designing fiscal-adjustment programs that preserve human-capital accumulation while achieving fiscal sustainability therefore remains a major challenge for policymakers.

Several avenues for future research deserve attention. First, future work could investigate whether the effects documented here vary according to the initial level of public debt, institutional quality, or the business cycle. Second, distinguishing between different categories of tax increases and expenditure cuts could provide a more detailed understanding of the mechanisms underlying our results. Finally, extending the analysis to broader measures of welfare, such as multidimensional poverty or subjective well-being, would further improve our understanding of the long-run social consequences of fiscal consolidation.

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## A Variable definitions and Descriptive statistics

Our Data is a panel of 14 sub-Saharan African economies observed over 1990–2024, for a total of 14 country-year observations. The sample comprises Angola, Cameroon, Côte d’Ivoire, the Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Mauritius, Mozambique, Nigeria, Senegal, South Africa, Tanzania and Uganda.

The panel is assembled to extend the narrative analysis of fiscal consolidation in sub-Saharan Africa of Abdel-Latif et al. (2026a) by replacing real output with the Human Development Index and its components as outcome variables. It accordingly combines fiscal-shock measures, human-development indicators and standard macroeconomic controls.

### A.1 Definitions

Table A.1 defines every variable retained for the analysis.

Table A.1: Definition of the variables

| Variable                                     | Definition                                                                                   | Unit                  | Source                                   |
|----------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------|------------------------------------------|
| <i>Panel identifiers</i>                     |                                                                                              |                       |                                          |
| IS03                                         | ISO 3166-1 alpha-3 country code; panel grouping key.                                         | —                     | —                                        |
| Pays                                         | Country name (French). Spelling is not standardised; do not group on this field.             | —                     | —                                        |
| Annee                                        | Calendar year.                                                                               | 1990–2024             | —                                        |
| <i>Outcome variables (human development)</i> |                                                                                              |                       |                                          |
| IDH                                          | Human Development Index, the geometric mean of the health, education and income sub-indices. | Index<br>$\in [0, 1]$ | <a href="#">Global Data Lab database</a> |
| Health index                                 | Health sub-index of the HDI, based on life expectancy at birth.                              | Index<br>$\in [0, 1]$ | <a href="#">Global Data Lab database</a> |
| Education index                              | Education sub-index of the HDI, based on mean and expected years of schooling.               | Index<br>$\in [0, 1]$ | <a href="#">Global Data Lab database</a> |

*Continued on next page*

Table A.1 (continued)

| Variable                                     | Definition                                                                                                                                                  | Unit                  | Source                                             |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------|
| <b>Standard of living</b>                    | Income sub-index of the HDI, based on the logarithm of gross national income per capita.                                                                    | Index<br>$\in [0, 1]$ | <a href="#">Global Data Lab database</a>           |
| <i>Fiscal-consolidation shocks</i>           |                                                                                                                                                             |                       |                                                    |
| <b>total</b>                                 | Narratively identified fiscal-consolidation shock; size of the announced consolidation. Satisfies the identity $\text{total} = \text{tax} + \text{spend}$ . | % of GDP              | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>tax</b>                                   | Tax-based (revenue) component of the consolidation shock.                                                                                                   | % of GDP              | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>spend</b>                                 | Spending-based (expenditure) component of the consolidation shock.                                                                                          | % of GDP              | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <i>Fiscal controls and CAPB construction</i> |                                                                                                                                                             |                       |                                                    |
| <b>govdebt_GDP</b>                           | Gross general-government debt. Entered with one lag as a control.                                                                                           | % of GDP              | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>ggxonlb_gdp</b>                           | General-government primary net lending/borrowing (primary balance); WEO code GGXONLB.                                                                       | % of GDP              | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>ggx</b>                                   | General-government total expenditure, level; WEO code GGX. Used to build the cyclically adjusted primary balance.                                           | Nat. currency         | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>ngdp</b>                                  | Nominal GDP, level; WEO code NGDP. Used to scale expenditure in the CAPB.                                                                                   | Nat. currency         | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <i>Macroeconomic state and controls</i>      |                                                                                                                                                             |                       |                                                    |
| <b>log_rgdp</b>                              | Natural logarithm of real (constant-price) GDP; used to build the output gap and the aid gap.                                                               | log level             | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>dlog_rgdp</b>                             | Real GDP growth rate. Already expressed in percent.                                                                                                         | Percent               | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |

Continued on next page

Table A.1 (continued)

| Variable                           | Definition                                                                                                                 | Unit                | Source                                             |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------|
| <b>inflation</b>                   | Consumer-price inflation, annual average. Includes genuine hyperinflation episodes (e.g. DR Congo 1994).                   | Percent             | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>gross_ODA_GDP</b>               | Gross official development assistance received, relative to GDP. <i>See data note below: raw units are not consistent.</i> | % of GDP (intended) | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>imf_program</b>                 | Indicator equal to 1 if the country is under an IMF-supported programme in year $t$ , 0 otherwise.                         | {0,1}               | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>dctot</b>                       | Annual change in the country-specific commodity terms-of-trade index.                                                      | Index pts           | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |
| <b>dtemp</b>                       | Annual change in country mean surface temperature; climate control.                                                        | °C                  | Climate data                                       |
| <i>Identification / validation</i> |                                                                                                                            |                     |                                                    |
| <b>forecast_revision</b>           | Revision to the WEO real-GDP-growth forecast; used to test the exogeneity (orthogonality) of the narrative shock.          | Pct. points         | Abdel-Latif et al. (2026a) <a href="#">dataset</a> |

## A.2 Descriptive statistics

### A.3 Sources

We assemble an annual panel of 14 Sub-Saharan African (SSA) countries observed over the period 1990–2024.<sup>7</sup>

The panel is organized around two main data sources. Human development outcomes are taken from the Subnational Human Development Database of the Global Data Lab (Smits and Permanyer, 2019; UNDP, 2022), while the fiscal-policy treatment of interest, narratively identified episodes of fiscal consolidation, is taken from Abdel-Latif et al. (2026a).

<sup>7</sup>The countries are Angola, Cameroon, Côte d’Ivoire, the Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Mauritius, Mozambique, Nigeria, Senegal, South Africa, Tanzania and Uganda.

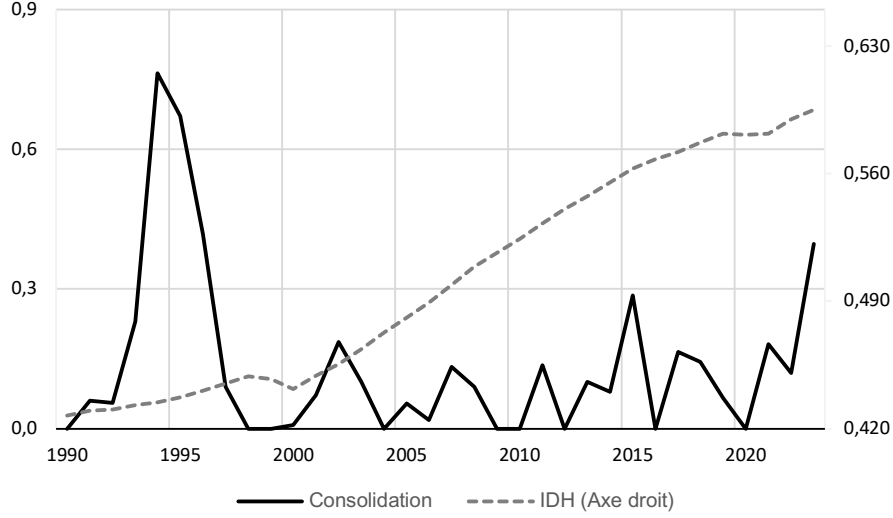
Table A.2: Descriptive statistics (pooled panel).

| variable  | libelle                       | N   | mean   | std dev. | min     | max     | median |
|-----------|-------------------------------|-----|--------|----------|---------|---------|--------|
| idh       | IDH                           | 457 | 0.504  | 0.112    | 0.245   | 0.806   | 0.492  |
| health    | Indice de santé               | 457 | 0.589  | 0.106    | 0.374   | 0.847   | 0.584  |
| edu       | Indice d'éducation            | 457 | 0.417  | 0.138    | 0.161   | 0.779   | 0.401  |
| rev       | Indice de revenu              | 457 | 0.537  | 0.126    | 0.237   | 0.847   | 0.535  |
| total     | Consolidation (totale, % PIB) | 481 | 0.142  | 0.474    | 0.000   | 5.100   | 0.000  |
| tax       | Hausses d'impôts (% PIB)      | 481 | 0.081  | 0.280    | 0.000   | 3.100   | 0.000  |
| spend     | Coupes de dépenses (% PIB)    | 481 | 0.062  | 0.253    | 0.000   | 2.000   | 0.000  |
| govdebt   | Dettes publiques (% PIB)      | 405 | 52.619 | 27.952   | 2.139   | 183.146 | 47.176 |
| primbal   | Solde primaire (% PIB)        | 429 | -0.748 | 3.369    | -13.679 | 29.012  | -1.034 |
| growth    | Croissance du PIB réel (%)    | 476 | 4.287  | 3.909    | -15.720 | 13.632  | 4.524  |
| inflation | Inflation (%)                 | 471 | 105.9  | 1143.3   | -8.238  | 23773.1 | 7.072  |
| dctot     | Var. termes de l'échange      | 476 | 0.102  | 2.410    | -19.187 | 12.880  | -0.034 |

Indicators (WDI) of the World Bank. Our empirical design extends the fiscal-multiplier analysis of by substituting the Human Development Index (HDI) and its components for the GDP-based outcomes used in the original study; accordingly, the data we collect mirror the inputs required by the doubly-robust (AIPW) estimator described.

**Outcome variables.** Our main dependent variable is the Human Development Index (HDI), a composite index bounded in  $[0, 1]$  that summarises a country's average achievement in three basic dimensions of human development: a long and healthy life, knowledge, and a decent standard of living. We obtain the HDI and each of its three sub-indices, i.e., the *health*, *education* and *income* indices, from the Global Data Lab (Smits and Permanyer, 2019), which harmonises the UNDP methodology over a long and internally consistent time span. Using the three sub-indices as alternative outcomes allows us to assess whether the response of human development to fiscal consolidation is driven by a particular dimension, and thereby provides a natural battery of dimension-by-dimension robustness checks. There is substantial cross-country variation in development outcomes. Over 1990–2024, the average HDI in the sample is 0.50 (standard deviation 0.11), with Mozambique recording the lowest country average (0.37) and Mauritius the highest (0.73); by 2023 these poles stand at 0.49 and 0.81, respectively. The dimension-specific extremes are equally informative: the health index is lowest in Nigeria and highest in Mauritius, the education index

Figure A.1: IDH and consolidation evolution



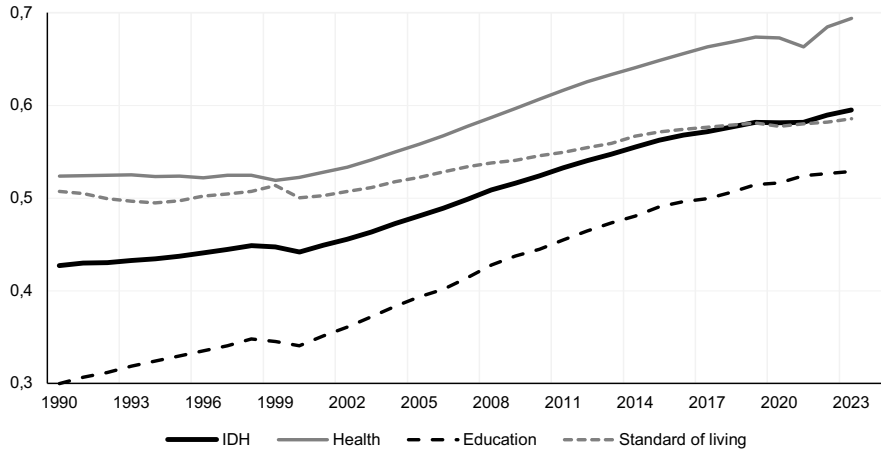
ranges from Senegal at the bottom to South Africa at the top, and the income index again spans Mozambique and Mauritius.

**The fiscal-consolidation shock.** Our regressor of interest is a narratively identified measure of discretionary fiscal consolidation, expressed as a percentage of HDI. Following the narrative approach pioneered by Romer and Romer (2010) and applied to fiscal consolidation by Pescatori et al. (2011, 2024) and Guajardo, Leigh, and Pescatori (2014), the Hanomics database records, for each country and year, the size of fiscal actions *motivated by a desire to reduce the budget deficit* rather than by the state of the cycle. This identification strategy is designed to isolate exogenous policy changes and thus to mitigate the reverse-causality concern that plagues conventional cyclically-driven measures. The total consolidation shock decomposes additively into a tax-based and a spending-based component,

$$\text{total}_{it} = \text{tax}_{it} + \text{spend}_{it}, \quad (21)$$

where  $\text{tax}_{it}$  captures legislated revenue increases and  $\text{spend}_{it}$  captures discretionary expenditure cuts. This decomposition lets us examine whether the composition of consolidation, i.e., tax hikes versus spending cuts, matters for human-development outcomes, in the spirit of the composition effects documented in the original study. Because consolidation is an episodic event, the shock series is zero in most country–

Figure A.2: Human Development Index and its components



years: the panel records 72 non-zero consolidation events (mean size conditional on action of 0.95% of HDI), concentrated in 12 of the 14 countries; Angola and the Democratic Republic of the Congo never record a narrative consolidation over the sample. The largest single episode is that of Côte d'Ivoire in 1994 (5.1% of HDI), followed by Ghana in 2015 (4.0%) and Cameroon in 1995 (3.2%).

**Covariates for the propensity score.** Because our identification of the average effect of consolidation relies on a doubly-robust (augmented inverse-probability-weighting, AIPW) estimator, we collect a set of covariates that govern the probability of entering a consolidation episode, the *propensity score*. These are the contemporaneous (and lagged) real GDP growth rate ( $\Delta \log \text{rgdp}$ ), the CPI inflation rate, and an indicator for an ongoing IMF-supported programme. Conditioning on these variables addresses the concern that governments select into consolidation for reasons, i.e., weak growth, high inflation, or the conditionality attached to a Fund programme, that are themselves correlated with subsequent human-development dynamics. Real GDP growth averages 4.3% per year (standard deviation 3.9) over the sample. Inflation is far more volatile: its sample mean of 106% and very large dispersion are driven by the hyperinflation episodes of the early 1990s, i.e., most notably the Democratic Republic of the Congo, where measured inflation exceeds 23,000% in 1994, and Angola in the mid-1990s. An IMF programme is in place in 46 country-years (9.4% of the panel), most frequently in Senegal and Tanzania (seven years each).

Table A.3: Correlation matrix

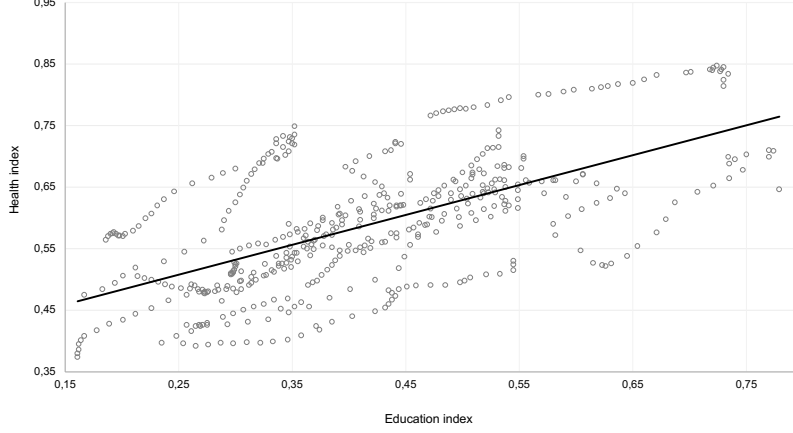
|         | idh   | health | edu   | rev   | total | tax   | spend | debt  | primbal | growth | rgdp  |
|---------|-------|--------|-------|-------|-------|-------|-------|-------|---------|--------|-------|
| idh     | 1.00  | 0.80   | 0.93  | 0.87  | -0.03 | -0.02 | -0.05 | -0.23 | -0.11   | -0.11  | -0.11 |
| health  | 0.80  | 1.00   | 0.64  | 0.58  | 0.02  | 0.02  | 0.01  | -0.17 | -0.30   | 0.02   | -0.26 |
| edu     | 0.93  | 0.64   | 1.00  | 0.70  | -0.08 | -0.06 | -0.09 | -0.20 | -0.10   | -0.12  | -0.03 |
| rev     | 0.87  | 0.58   | 0.70  | 1.00  | 0.00  | 0.01  | -0.01 | -0.25 | 0.07    | -0.16  | -0.05 |
| total   | -0.03 | 0.02   | -0.08 | 0.00  | 1.00  | 0.90  | 0.88  | 0.13  | 0.01    | -0.04  | 0.01  |
| tax     | -0.02 | 0.02   | -0.06 | 0.01  | 0.90  | 1.00  | 0.58  | 0.13  | 0.01    | -0.03  | -0.03 |
| spend   | -0.05 | 0.01   | -0.09 | -0.01 | 0.88  | 0.58  | 1.00  | 0.10  | 0.01    | -0.04  | 0.05  |
| debt    | -0.23 | -0.17  | -0.20 | -0.25 | 0.13  | 0.13  | 0.10  | 1.00  | -0.01   | -0.15  | -0.11 |
| primbal | -0.11 | -0.30  | -0.10 | 0.07  | 0.01  | 0.01  | 0.01  | -0.01 | 1.00    | 0.03   | 0.20  |
| growth  | -0.11 | 0.02   | -0.12 | -0.16 | -0.04 | -0.03 | -0.04 | -0.15 | 0.03    | 1.00   | -0.04 |
| rgdp    | -0.11 | -0.26  | -0.03 | -0.05 | 0.01  | -0.03 | 0.05  | -0.11 | 0.20    | -0.04  | 1.00  |

**Controls and fiscal state variables.** We control for a set of macroeconomic conditions that may independently affect both fiscal policy and human development. Gross public debt, expressed as a share of HDI and entered with a lag, captures the fiscal space available to the government; it averages 52.6% of HDI in the sample, ranging from a country-average low in Nigeria (31.5%) to a high in Angola (74.9%). We also include two “world-event” controls, each entered with two lags: the annual change in the (commodity) terms of trade, which captures external price shocks of particular relevance to commodity-dependent SSA economies, and the annual change in temperature, a climatic control. To characterize the fiscal state and to construct the instrument used in our robustness analysis (see below), we additionally collect the general-government primary balance (ggxonlb\_gdp, % of HDI), total government expenditure (ggx), nominal GDP (ngdp) and log real GDP (logrgdp). The primary balance averages  $-0.75\%$  of HDI over the sample. Finally, gross official development assistance (ODA) as a share of GDP is used to define the high- versus low-aid regimes against which we examine the heterogeneity of the consolidation response.

**Construction of the cyclically-adjusted balance and validation of the shock.**

As a robustness check on the narrative measure, we follow the cyclically-adjusted-balance literature (Blanchard and Perotti, 2002; Girouard and André, 2005) and build a cyclically-adjusted primary balance (CAPB) from the components above. Letting  $\text{gap}_{it}$  denote the output gap obtained by detrending  $\text{logrgdp}_{it}$ , the CAPB

Figure A.3: Correlation Health and Education



removes the automatic, cycle-induced movement in the primary balance,

$$\text{capb}_{it} = \text{pb}_{it} - \varepsilon \text{gap}_{it}, \quad (22)$$

where  $\text{pb}_{it} = \text{ggxonlb\_gdp}_{it}$  is the headline primary balance and  $\varepsilon$  is the semi-elasticity of the budget to the cycle; the change in the CAPB serves as an instrument for fiscal effort. Before turning to estimation, we assess the central identifying assumption that narrative consolidations are unanticipated, that is, orthogonal to expected future output. We use the WEO growth-forecast revision (`forecast_revision`) as a proxy for fiscal “news” and verify, in the spirit of Guajardo, Leigh, and Pescatori (2014), that the shock is uncorrelated with prior forecast revisions, so that the consolidation series can be treated as plausibly exogenous to the human-development outcomes we study.

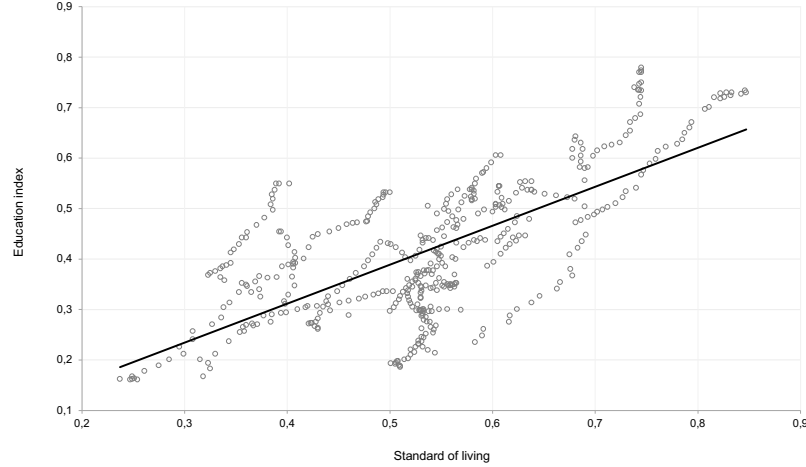
**Descriptive statistics.** Table A.4 reports descriptive statistics for the variables used in the analysis, grouped by their role in the empirical model: outcome variables, the fiscal-consolidation shock, the propensity-score covariates, and the controls and fiscal-state variables. For each variable we report the number of available observations, the panel mean, the standard deviation, and the minimum and maximum.

Table A.4: Descriptive statistics

| Variable                                                        | Obs. | Mean    | Std. dev. | Min     | Max       |
|-----------------------------------------------------------------|------|---------|-----------|---------|-----------|
| <i>Panel A. Outcome variables (Global Data Lab)</i>             |      |         |           |         |           |
| Human Development Index (HDI)                                   | 457  | 0.504   | 0.112     | 0.245   | 0.806     |
| Health sub-index                                                | 457  | 0.589   | 0.106     | 0.374   | 0.847     |
| Education sub-index                                             | 457  | 0.417   | 0.138     | 0.161   | 0.779     |
| Income sub-index                                                | 457  | 0.537   | 0.126     | 0.237   | 0.847     |
| <i>Panel B. Fiscal-consolidation shock (Hanomics, % of GDP)</i> |      |         |           |         |           |
| Total consolidation                                             | 481  | 0.142   | 0.474     | 0.000   | 5.100     |
| Tax-based component                                             | 481  | 0.081   | 0.280     | 0.000   | 3.100     |
| Spending-based component                                        | 481  | 0.062   | 0.253     | 0.000   | 2.000     |
| <i>Panel C. Propensity-score covariates (AIPW)</i>              |      |         |           |         |           |
| Real GDP growth (%)                                             | 476  | 4.287   | 3.909     | -15.720 | 13.632    |
| CPI inflation (%)                                               | 471  | 105.895 | 1143.287  | -8.238  | 23773.100 |
| IMF programme (0/1)                                             | 490  | 0.094   | 0.292     | 0.000   | 1.000     |
| <i>Panel D. Controls and fiscal state</i>                       |      |         |           |         |           |
| Public debt (% of GDP, lagged)                                  | 405  | 52.619  | 27.952    | 2.139   | 183.146   |
| $\Delta$ terms of trade                                         | 476  | 0.102   | 2.410     | -19.187 | 12.880    |
| $\Delta$ temperature ( $^{\circ}\text{C}$ )                     | 476  | 0.019   | 0.282     | -1.100  | 0.900     |
| Primary balance (% of GDP)                                      | 429  | -0.748  | 3.369     | -13.679 | 29.012    |

Note: The sample is an annual panel of 14 Sub-Saharan African countries observed over 1990–2024 (490 potential country–year observations). Outcome variables are the HDI and its three sub-indices from the Global Data Lab (Smits and Permanyer, 2019); each is bounded in  $[0, 1]$ . The fiscal- consolidation shock is a narratively identified measure of discretionary consolidation (% of GDP) from the Hanomics Fiscal Narrative Database (Hanomics, 2024), with total = tax+spend; it is zero in country–years without a consolidation episode. The large mean and dispersion of inflation are driven by the hyperinflation episodes of the Democratic Republic of the Congo and Angola in the early-to-mid 1990s. The total number of usable observations in any given specification is smaller than the figures above because (i) the HDI is unavailable for 2024 at the time of writing and is sparse before 2000, and (ii) the terms-of-trade and temperature controls enter with two lags. Country names are reconciled on the ISO3 country code.

Figure A.4: Correlation Education and standard of living



## B Estimation of IRF by Local Projections

This appendix provides a step-by-step derivation of impulse response function (IRF) based on the local projections approach. Before presenting the estimation procedure, it is useful to recall the economic intuition underlying impulse response analysis and why IRFs are a natural tool for studying the dynamic effects of fiscal consolidation shocks.

### B.1 Impulse Response Analysis

In macroeconomics, many policy interventions do not affect outcomes only at the moment when they occur. A fiscal consolidation implemented in year  $t$  may affect GDP or, as in the present study, human development immediately, but it may also affect it one, two, or several years later.

Let  $HDI_{i,t}$  denote the Human Development Index, or alternatively one of its three constituent dimensions (i.e., health, education, and income), of country  $i$  in year  $t$ . Let  $\Delta FC_{i,t}$  denote a fiscal consolidation shock, expressed as a percentage of GDP. The objective of impulse response analysis is to describe what is the effect of a fiscal consolidation shock at time  $t$  on human development at future horizons  $t + h$ ?

The answer is summarized by an IRF:

$$IRF_h = \frac{\partial HDI_{i,t+h}}{\partial \Delta FC_{i,t}}, \quad h = 0, 1, \dots, H. \quad (23)$$

where the horizon  $h = 0$  measures the contemporaneous effect, while  $h = 1$ ,  $h = 2$ , and higher values of  $h$  measure delayed effects.

## B.2 A First Building Block: The AR(1) Model

Let's begin with a simple first-order autoregressive model, denoted AR(1):

$$y_t = \rho y_{t-1} + \varepsilon_t, \quad (24)$$

where  $y_t$  is a macroeconomic variable,  $\rho$  measures persistence, and  $\varepsilon_t$  is an innovation or shock. The parameter  $\rho$  tells us how much of the past carries over into the present. If  $\rho$  is close to zero, the process has little memory. If  $\rho$  is close to one, shocks are highly persistent. For stability, we assume:

$$|\rho| < 1. \quad (25)$$

This condition ensures that the effect of shocks gradually fades over time.

Then starting from equation (24), one period ahead we have:

$$y_{t+1} = \rho y_t + \varepsilon_{t+1}. \quad (26)$$

Since:

$$y_t = \rho y_{t-1} + \varepsilon_t, \quad (27)$$

we substitute  $y_t$  into the equation for  $y_{t+1}$ :

$$\begin{aligned} y_{t+1} &= \rho(\rho y_{t-1} + \varepsilon_t) + \varepsilon_{t+1} \\ &= \rho^2 y_{t-1} + \rho \varepsilon_t + \varepsilon_{t+1}. \end{aligned} \quad (28)$$

Two periods ahead:

$$\begin{aligned} y_{t+2} &= \rho y_{t+1} + \varepsilon_{t+2} \\ &= \rho(\rho^2 y_{t-1} + \rho \varepsilon_t + \varepsilon_{t+1}) + \varepsilon_{t+2} \\ &= \rho^3 y_{t-1} + \rho^2 \varepsilon_t + \rho \varepsilon_{t+1} + \varepsilon_{t+2}. \end{aligned} \quad (29)$$

More generally:

$$y_{t+h} = \rho^{h+1}y_{t-1} + \sum_{j=0}^h \rho^j \varepsilon_{t+h-j}. \quad (30)$$

The coefficient of the shock  $\varepsilon_t$  in equation (30) is  $\rho^h$ . Therefore, the effect of a shock at time  $t$  on  $y_{t+h}$  is:

$$IRF(h) = \rho^h. \quad (31)$$

For a shock of size  $\delta$ , the response is:

$$IRF(h) = \rho^h \delta. \quad (32)$$

### B.3 From AR(1) to the MA( $\infty$ ) Representation

The AR(1) model can also be written as an infinite moving average representation. Starting again from:

$$y_t = \rho y_{t-1} + \varepsilon_t, \quad (33)$$

substitute  $y_{t-1}$ :

$$\begin{aligned} y_t &= \rho(\rho y_{t-2} + \varepsilon_{t-1}) + \varepsilon_t \\ &= \rho^2 y_{t-2} + \rho \varepsilon_{t-1} + \varepsilon_t. \end{aligned} \quad (34)$$

Substituting repeatedly gives:

$$y_t = \rho^k y_{t-k} + \sum_{j=0}^{k-1} \rho^j \varepsilon_{t-j}. \quad (35)$$

If  $|\rho| < 1$ , then  $\rho^k y_{t-k} \rightarrow 0$  as  $k \rightarrow \infty$ . Hence:

$$y_t = \sum_{j=0}^{\infty} \rho^j \varepsilon_{t-j}. \quad (36)$$

This is the MA( $\infty$ ) representation. It shows that the current value of  $y_t$  is the weighted sum of current and past shocks.

### B.4 VAR Specification

Macroeconomic variables rarely evolve in isolation. Human development, fiscal consolidation, GDP growth, debt, inflation, and external financing conditions may all

influence one another. To represent such interactions, economists often use a vector autoregression (VAR). Let

$$Y_t = \begin{pmatrix} HDI_t \\ FC_t \end{pmatrix}. \quad (37)$$

A simple VAR(1) can be written as:

$$Y_t = AY_{t-1} + u_t, \quad (38)$$

where

$$A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}, \quad u_t = \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix}. \quad (39)$$

In expanded form:

$$HDI_t = a_{11}HDI_{t-1} + a_{12}FC_{t-1} + u_{1t}, \quad (40)$$

$$FC_t = a_{21}HDI_{t-1} + a_{22}FC_{t-1} + u_{2t}. \quad (41)$$

The coefficient  $a_{12}$ , for example, captures how past fiscal consolidation is associated with current human development, while  $a_{21}$  captures how past human development is associated with current fiscal policy.

As with the AR(1), we can substitute recursively:

$$Y_t = AY_{t-1} + u_t, \quad (42)$$

$$Y_{t-1} = AY_{t-2} + u_{t-1}. \quad (43)$$

Therefore:

$$\begin{aligned} Y_t &= A(AY_{t-2} + u_{t-1}) + u_t \\ &= A^2Y_{t-2} + Au_{t-1} + u_t. \end{aligned} \quad (44)$$

After  $k$  substitutions:

$$Y_t = A^kY_{t-k} + \sum_{j=0}^{k-1} A^j u_{t-j}. \quad (45)$$

If the VAR is stable, then  $A^kY_{t-k} \rightarrow 0$ , and:

$$Y_t = \sum_{j=0}^{\infty} A^j u_{t-j}. \quad (46)$$

The matrix  $A^h$  describes how shocks propagate over time. Therefore, the VAR impulse response at horizon  $h$  is obtained from powers of  $A$ :

$$IRF(h) = A^h. \quad (47)$$

This approach is powerful, but it requires specifying the entire dynamic system. If the VAR is misspecified, the resulting impulse responses may also be affected.

## B.5 Baseline LP Model for Human Development

Local projections, introduced by Òscar Jordà (2005), provide a direct alternative<sup>8</sup>. Instead of estimating a full VAR and then computing  $A^h$ , local projections estimate the response at each horizon  $h$  directly. The key idea is simple: Instead of deriving  $y_{t+h}$  from a full dynamic system, estimate  $y_{t+h}$  directly on the shock at  $t$ . For each horizon  $h$ , we estimate a separate regression:

$$y_{t+h} = \alpha_h + \theta_h shock_t + \Gamma'_h X_t + e_{t+h}. \quad (48)$$

The coefficient  $\theta_h$  is then interpreted as the impulse response at horizon  $h$ :

$$IRF(h) = \theta_h. \quad (49)$$

Thus, local projections transform the impulse response problem into a sequence of ordinary least squares regressions.

In our empirical application, the outcome is the change in the Human Development Index between  $t - 1$  and  $t + h$ :

$$HDI_{i,t+h} - HDI_{i,t-1}. \quad (50)$$

Let  $\Delta FC_{i,t}$  denote a narrative fiscal consolidation shock. For each projection horizon  $h \in \{0, 1, \dots, H\}$ , the baseline linear local projection model is:

$$HDI_{i,t+h} - HDI_{i,t-1} = \mu_{i,h} + \tau_{t,h} + \beta_h \sum_{j=0}^h \Delta FC_{i,t+j} + \Omega'_h X_{i,t} + \varepsilon_{i,t+h}. \quad (51)$$

Here,  $i$  indexes countries and  $t$  denotes years. The term  $\mu_{i,h}$  captures country fixed effects, while  $\tau_{t,h}$  captures time fixed effects. The vector  $X_{i,t}$  includes macroeconomic

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<sup>8</sup>Jordà, Òscar, 2005, “Estimation and Inference of Impulse Responses by Local Projections,” *The American Economic Review*, vol. 95, no. 1, 161–182. Url: <https://www.jstor.org/stable/4132675>.

and fiscal controls, and  $\varepsilon_{i,t+h}$  is the error term. The coefficient  $\beta_h$  measures the average response of human development to fiscal consolidation at horizon  $h$ :

$$\beta_h = \frac{\partial (HDI_{i,t+h} - HDI_{i,t-1})}{\partial \left( \sum_{j=0}^h \Delta FC_{i,t+j} \right)}. \quad (52)$$

Therefore:

$$IRF_h = \beta_h. \quad (53)$$

The linear model assumes that the effect of fiscal consolidation on human development is the same across countries and macroeconomic states.

The assumption of a constant effect may be restrictive. Fiscal consolidation may affect human development differently depending on the macroeconomic environment. For example, consolidation may have larger adverse effects when economic activity is weak, when public debt is high, when external financing is limited, or when macroeconomic instability is severe. Conversely, the same consolidation episode may be less damaging when growth is strong, fiscal space is available, aid inflows are supportive, or inflation is stable.

To capture this possibility, we allow the response coefficient to depend on a state variable  $Z_{i,t}$ :

$$\beta_h \longrightarrow \beta_h(Z_{i,t}). \quad (54)$$

The variable  $Z_{i,t}$  denotes a normalized state variable that captures the prevailing macroeconomic environment through business cycle conditions, fiscal stance, external financing conditions, and macroeconomic stability. The general state-dependent LP model is:

$$HDI_{i,t+h} - HDI_{i,t-1} = \mu_{i,h} + \tau_{t,h} + \Omega'_h X_{i,t} + \beta_h(Z_{i,t}) \sum_{j=0}^h \Delta FC_{i,t+j} + \varepsilon_{i,t+h}. \quad (55)$$

We assume that the response can vary smoothly between two regimes. Let  $\beta_{h,L}$  denote the response in a low state, and let  $\beta_{h,H}$  denote the response in a high state.

The state-dependent coefficient is written as:

$$\beta_h(Z_{i,t}) = F(Z_{i,t})\beta_{h,L} + [1 - F(Z_{i,t})]\beta_{h,H}. \quad (56)$$

The function  $F(Z_{i,t})$  is a logistic transition function:

$$F(Z_{i,t}) = \frac{\exp(-\gamma Z_{i,t})}{1 + \exp(-\gamma Z_{i,t})}, \quad \gamma > 0. \quad (57)$$

It satisfies:

$$0 < F(Z_{i,t}) < 1. \quad (58)$$

When  $Z_{i,t} \rightarrow -\infty$ :

$$F(Z_{i,t}) \rightarrow 1, \quad \beta_h(Z_{i,t}) \rightarrow \beta_{h,L}. \quad (59)$$

When  $Z_{i,t} \rightarrow +\infty$ :

$$F(Z_{i,t}) \rightarrow 0, \quad \beta_h(Z_{i,t}) \rightarrow \beta_{h,H}. \quad (60)$$

At  $Z_{i,t} = 0$ :

$$F(0) = \frac{1}{2}, \quad (61)$$

so that:

$$\beta_h(0) = \frac{1}{2}\beta_{h,L} + \frac{1}{2}\beta_{h,H}. \quad (62)$$

Thus, the model allows the response to change gradually from one regime to another.

Substituting equation (56) into equation (55) gives:

$$\begin{aligned} HDI_{i,t+h} - HDI_{i,t-1} = & \mu_{i,h} + \tau_{t,h} + \Omega'_h X_{i,t} \\ & + [F(Z_{i,t})\beta_{h,L} + (1 - F(Z_{i,t}))\beta_{h,H}] \sum_{j=0}^h \Delta FC_{i,t+j} + \varepsilon_{i,t+h}. \end{aligned} \quad (63)$$

Expanding the interaction terms gives the estimable equation:

$$\begin{aligned} HDI_{i,t+h} - HDI_{i,t-1} = & \mu_{i,h} + \tau_{t,h} + \Omega'_h X_{i,t} \\ & + \beta_{h,L} \left[ F(Z_{i,t}) \sum_{j=0}^h \Delta FC_{i,t+j} \right] \\ & + \beta_{h,H} \left[ (1 - F(Z_{i,t})) \sum_{j=0}^h \Delta FC_{i,t+j} \right] + \varepsilon_{i,t+h}. \end{aligned} \quad (64)$$

This form shows that the fiscal consolidation shock is interacted with two regime weights:  $F(Z_{i,t})$  and  $1 - F(Z_{i,t})$ . The coefficient  $\beta_{h,L}$  captures the response of human development to fiscal consolidation in a low state. The coefficient  $\beta_{h,H}$  captures the response in a high state.

Let  $s_{i,t}$  denote the raw state variable. For example,  $s_{i,t}$  may be real GDP growth, public debt as a percentage of GDP, development aid, or inflation. We normalize it as:

$$Z_{i,t} = \frac{s_{i,t} - \bar{s}_i}{\sigma(s_i)}, \quad (65)$$

where  $\bar{s}_i$  is the country-specific mean and  $\sigma(s_i)$  is the country-specific standard deviation. After normalization:

$$E(Z_{i,t}) = 0, \quad Var(Z_{i,t}) = 1. \quad (66)$$

This transformation makes the state variable comparable across countries. The parameter  $\gamma$  controls how rapidly the economy moves between the low and high regimes. If  $\gamma$  is small, the transition is gradual. If  $\gamma$  is large, the transition becomes sharper. In the limit:

$$\gamma \rightarrow \infty \quad \Rightarrow \quad F(Z_{i,t}) \approx \mathbb{1}\{Z_{i,t} < 0\}. \quad (67)$$

Thus, a very large  $\gamma$  makes the smooth-transition model close to a threshold model. By contrast, a moderate value of  $\gamma$  allows the effect of fiscal consolidation to vary continuously with the economic environment.

The impulse response of human development to fiscal consolidation is now:

$$IRF_h(Z_{i,t}) = F(Z_{i,t})\beta_{h,L} + [1 - F(Z_{i,t})]\beta_{h,H}. \quad (68)$$

For a fiscal consolidation shock of one percent of GDP, the response of human development at horizon  $h$  is:

$$\Delta HDI_h(Z_{i,t}) = IRF_h(Z_{i,t}) \times 1 = F(Z_{i,t})\beta_{h,L} + [1 - F(Z_{i,t})]\beta_{h,H}. \quad (69)$$

The difference between low-state and high-state responses is:

$$\Delta_h^{L-H} = \beta_{h,L} - \beta_{h,H}. \quad (70)$$

If  $\Delta_h^{L-H}$  is statistically different from zero, then the effect of fiscal consolidation on human development depends on the state of the economy.

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