

FISCAL DECENTRALIZATION AND THE HIV TREATMENT CASCADE IN LOW- AND
MIDDLE-INCOME COUNTRIES: IDENTIFYING OPPORTUNITIES TO SUSTAIN
PROGRESS MADE UNDER THE PRESIDENT’S EMERGENCY PLAN FOR AIDS RELIEF

by

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ABSTRACT

The United States’ President’s Emergency Plan for AIDS Relief (PEPFAR) has provided technical and financial support to the most burdened low- and middle-income countries (LMICs) for over 20 years, leading to gains toward HIV epidemic control. As global donor priorities shift, and more LMICs seek to assume control of their national HIV programs, there is an increased need to identify structural opportunities to sustain these gains. While the literature has suggested a relationship between government decentralization and individual- and population-level HIV outcomes in LMICs, its direction is unclear, and little is known about the effect of global donor programs on this relationship.

This ecological, cross-national study employed an ordinary least squares regression model and a panel regression model (2010-2019) to explore the relationship between fiscal decentralization, reduction in HIV incidence, and three HIV treatment cascade outcomes in 96 LMICs. Results indicate that LMICs with PEPFAR programs were more effective at controlling their HIV epidemics than those without, and higher degrees of fiscal decentralization were associated with reduced HIV incidence (2019-2010), increased awareness of personal HIV

status, and increased participation in anti-retroviral therapy (ART). PEPFAR did not appear to have a moderating effect on the relationship between the three HIV treatment cascade variables and fiscal decentralization, though it may moderate the relationship between 1) fiscal decentralization and reductions in HIV incidence and 2) political decentralization and the percentage of people living with HIV receiving ART. PEPFAR programs appear more successful in countries with lower degrees of political decentralization and higher degrees of fiscal decentralization. Fiscal decentralization may help LMICs reach HIV epidemic control through reduced incidence and achievement of the HIV treatment cascade 95-95-95 goals. Countries seeking to take over their national HIV programs and sustain PEPFAR progress should identify and leverage opportunities to better align HIV policies and practices with decentralization policies and institutions.

INDEX WORDS: Human immunodeficiency virus, HIV, HIV treatment cascade, President's Emergency Plan for AIDS Relief, PEPFAR, Decentralization, Fiscal decentralization, Low- and middle-income countries, LMIC

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DEDICATION

This project is dedicated to my mother Gail P. Nevins

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Obtaining this degree is a lifelong goal and it would not have been possible without the support of my family. My husband, Dr. Mathew Sapiano, provided endless encouragement and guidance throughout the process. His love and patience are seemingly endless, and I and my dissertation are better for it. My sons Oliver and Miles gracefully sacrificed precious evening and weekend time with Mom for the sake of this pursuit. I am proud that they have observed my dedication and hard work throughout this process, and I hope that my unwavering commitment to achieving my goal remains a lifelong source of inspiration and a reminder to continue pursuing their goals, no matter what age.

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CHAPTER 1: INTRODUCTION

Problem Statement

Government decentralization is a key tenet of democracy. It is rooted in the belief that decentralization improves both the democratic process and public service delivery by moving functions and resources away from the national government to lower-level institutions and elected representatives closer to the citizens. For the last 40 years, low- and middle-income countries (LMIC) have been working to constitutionalize and legislate decentralization policies and activities, at the behest of global development organizations seeking to increase democratic governance around the world.

The relationship between decentralization and the ability of countries to effectively manage infectious disease outbreaks is unknown. For the past three decades, HIV has presented a significant global health threat, with LMICs shouldering a disproportionate burden of the disease. For the past 20 years, the global HIV response has relied on donor programs, primarily the United States' bilateral program, The President's Emergency Plan for AIDS Relief (PEPFAR), to fund national HIV programs in the highest-burden countries.

Since inception, PEPFAR has leveraged outsized diplomatic and financial influence in dozens of LMIC, using a centralized approach to funding as well as administrative, policy, and program support. PEPFAR currently provides antiretroviral therapy (ART) to more than three-quarters of people living with HIV in LMICs globally (CDC, 2022). Alongside its funding of direct service delivery, the program has provided LMICs billions of dollars over the past decade, building their capacity to assume control of their own national HIV programs and achieve and sustain HIV epidemic control. Despite these efforts, PEPFAR-supported countries continue to

score low on PEPFAR's measures of sustainability. These low sustainability scores suggest that countries are not yet positioned to assume control of their national HIV programs in a way that will ensure sustainability of HIV treatment gains made under PEPFAR.

While PEPFAR aims to promote sustainability and, ultimately, country ownership of national HIV programs, its structure and approach may be antagonistic to this goal. Specifically, successful HIV responses may be benefiting from PEPFAR's strategic centralization of funding, administrative, policy, and program support. For most LMIC, a centralized national HIV response is likely be at odds with their national decentralization strategy. The unintended consequences of this dichotomy could inhibit the ability of countries to achieve and sustain HIV treatment goals in the absence of PEPFAR.

Background

Global HIV Epidemic

Since 1982, 84.2 million people have been infected with HIV, and 40.1 million people have died from AIDS-related illnesses around the world (UNAIDS, 2022). In 2021, 38.4 million people were living with HIV, and 1.5 million new HIV infections and approximately 650,000 AIDS-related deaths took place (UNAIDS, 2022). Low- and middle-income countries (LMICs) bear a disproportionate burden of the HIV epidemic (Shao & Williamson, 2012). In 2021, 33.9 million (88.2%) of the 38.4 million people living with HIV globally were residing in LMICs (CDC, 2022; UNAIDS, 2022).

The epidemiological data from 2021 demonstrates that HIV incidence and AIDS-related mortality have reduced significantly over the last two decades. Between 2001 and 2021, annual HIV incidence decreased from 3.4 million to 1.5 million (Harries et al., 2016; Holmes et al., 2017; UNAIDS, 2022). Similarly, the number of global AIDS-related deaths fell from an

estimated 2 million in 2001 to 650,000 in 2021, representing a 50% decline in global HIV incidence and AIDS-related mortality (Holmes et al., 2017; UNAIDS, 2022).

This steep decline in HIV incidence and AIDS-related mortality has been accompanied by significant increases in the number of people receiving ART in LMICs, which rose 20-fold between 2003-2021 (PEPFAR, 2021a). Of the 33.9 million people living with HIV in LMICs in 2021, 25.7 million (75.8%) were accessing ART (CDC, 2022; Global HIV Hepatitis and Sexually Transmitted Infections Programmes, 2022). The President's Emergency Fund for AIDS Relief (PEPFAR) was responsible for providing ART access to 18.96 million people (73.7% of 25.7 million total LMIC ART recipients) in 2021 (PEPFAR, 2021b).

The U.S. President's Emergency Fund for AIDS Relief Achievements

PEPFAR, launched by the George H.W. Bush Administration in 2003, was initially conceived and implemented as a five-year, \$15 billion emergency response, designed to build the systems and infrastructure needed to quickly scale up HIV treatment access and prevention services in 15 low and middle-income countries (Bass, 2021; Donnelly, 2012; Lefkowitz, 2009; Varmus, 2013). At the time, HIV threatened individuals, fragile health systems, and global security, and reversed social and economic development gains made in LMICs (Boutayeb, 2009). The selected 15 countries were shouldering more than 50% of the global HIV burden; they were also countries where the U.S. government already had a strong presence (Bass, 2021; Donnelly, 2012).

Over the past 19 years, PEPFAR has become the largest bilateral global donor program focused on a single disease in history (PEPFAR, 2021c). PEPFAR has invested more than 100 billion U.S. dollars in responding to HIV and working toward HIV epidemic control and sustainability in over 45 countries (CDC, 2022; PEPFAR, 2021b). To date, PEPFAR support has

averted more than 16 million HIV infections and provided access to antiretroviral therapy for more than 28 million people; in 2021, PEPFAR supported HIV testing services to 63.4 million people (PEPFAR, 2021b, 2021c).

As of September 2021, PEPFAR has helped 20 of its 45 countries achieve one of two benchmarks for ending their HIV epidemics. The first of these measures, HIV epidemic control, is defined as the point at which the total number of new HIV infections falls below the total number of deaths, from all causes, among people living with HIV. The second is the achievement of the UNAIDS 95-95-95 targets (PEPFAR, 2021b), 95% of people living with HIV (PLWH) know their HIV status, 95% of people who know their HIV status are receiving ARTs, and 95% of people on ART have achieved viral load suppression (PEPFAR, 2021b).

In addition to providing HIV treatment, PEPFAR supports prevention initiatives. In 2021, PEPFAR provided HIV testing services to 63.4 million people and pre-exposure prophylaxis (PrEP) to 1 million people. PEPFAR has conducted more than 27 million voluntary medical male circumcisions and provided critical care and support to more than seven million orphans, vulnerable children, and their caregivers in LMICs.

PEPFAR Transition and Sustainability

PEPFAR's results are impressive. However, as Harman (2015) points out, the constant evocation of the positive narrative around the program can be misleading. While the PEPFAR story can help justify further investment and attention from the international community, it may also be obfuscating programmatic limitations which could be inhibiting the abilities of recipient countries to achieve or sustain HIV epidemic control in its absence.

PEPFAR's programmatic achievements have led to its continuous reauthorization by the U.S. Congress since 2003, with each reauthorization expanding its focus and scope. During

PEPFAR Phase I (2003-2008), the program was considered an emergency response. During Phase II (2009-2013), PEPFAR transitioned to a targeted sustainable response approach that focused on increased country ownership. During Phase III (2014-2018), PEPFAR utilized a very targeted approach to drive epidemic control amongst populations and geographic areas with the highest HIV incidence rates. PEPFAR is currently in Phase IV (2018-current). During the current phase (Phase IV, 2018-), PEPFAR has prioritized working with recipient country governments to establish sustainable country-owned national responses. To maximize impact, the goal of sustainable national responses is to be able to maintain or achieve HIV epidemic control in the absence of PEPFAR (PEPFAR, 2022af).

In December 2022, PEPFAR released its latest five-year strategy document, *Fulfilling America's Promise to End the HIV/AIDS Pandemic by 2030* (PEPFAR, 2022af). One of the priority objectives is to support recipient countries to assume ownership of their national HIV/AIDS response and to achieve and sustain HIV epidemic control by 2030. As described in the report, PEPFAR's latest sustainability framework focuses on supporting countries in the following four focus areas: 1) developing a country-led sustainability roadmap; 2) accelerating integration of vertical HIV/AIDS programming into health and social service systems; 3) sustaining impact through local and regional organization implementation, and 4) engaging in integrated national planning (PEPFAR, 2022af).

PEPFAR, which has been engaging in sustainability discussions since 2012, began directing funding to sustainability activities in 2013 (Vogus & Graff, 2015). In 2015, to measure progress toward sustainability, PEPFAR created the Sustainability Index and Dashboard (SID), intended to: 1) help countries better understand their sustainability landscape; 2) inform priority areas for PEPFAR investment in countries; 3) serve as a diplomatic advocacy or negotiation tool

to dialogue with partner governments and multilateral counterparts; and 4) communicate progress towards sustained epidemic control to external stakeholders (Biradavolu et al., 2017). The SID assesses the current state of sustainability of the national HIV/AIDS response in PEPFAR countries and tracks progress over time. PEPFAR countries have been required to complete SIDs every two years since 2015.

The SID includes 100 questions, representing 17 core elements across four domains: governance, leadership, and accountability; national health systems and service delivery; financing and market openness; and strategic information (PEPFAR, 2016). Data is collected through consultations or stakeholder meetings with government, civil society, private sector, other donors, and multilateral organizations. Participants must reach consensus response, using documented data verification, as possible (PEPFAR, 2016).

The SID scoring scale provides a range of points, from 0-10, for four possible program sustainability grades. A score of 0-3.49 points indicates that the current PEPFAR program is unsustainable for the recipient country, which will require significant investment to be able to assume ownership of their program and maintain progress toward epidemic control (PEPFAR, 2022ae). A score of 3.50-6.99 points suggests emerging sustainability: the recipient country will need some continued investment to assume ownership of their program and maintain progress (PEPFAR, 2022ae). A score of 7.0-8.49 points indicates a level of program maturity that will soon allow the recipient country to take control and maintain progress made under PEPFAR with minimal to no additional investment (PEPFAR, 2022ae). A PEPFAR program that scores between 8.50-10.00 points is thought to be fully sustainable, requiring no additional support for the recipient country to assume ownership and maintain the progress made toward epidemic control under PEPFAR (PEPFAR, 2022ae).

Table 1 highlights the average SID scores across countries from 2015-2021. An incremental positive shift is observed between 2015, 2017, and 2019; however, the overall sustainability score declined between 2019 and 2021, possibly due to a loss of gains associated with the COVID-19 pandemic. Overall, the sustainability scores remain low (within the 3.50-6.99 range), despite almost 10 years of dedicated sustainability-focused activities (PEPFAR, 2022a, 2022b, 2022c, 2022d, 2022e, 2022f, 2022g, 2022h, 2022i, 2022j, 2022k, 2022l, 2022m, 2022n, 2022o, 2022p, 2022q, 2022r, 2022s, 2022t, 2022u, 2022v, 2022w, 2022x, 2022y, 2022z, 2022aa, 2022ab, 2022ac, 2022ad, 2022ae).

Table 1: Annual Aggregated SID Scores

	N	2015	2017	2019	2021
Mean SID score per year	26	5.8	6.3	6.7	6.6
Minimum SID score per year	26	3.0	3.5	4.6	2.9
Maximum SID score per year	26	7.9	8.2	8.6	8.5

Note. 2015 and 2017 mean scores were calculated based on a total of 15 indicators. The years 2019 and 2021 mean scores are calculated based on a total of 17 indicators. Data were included for 26 countries for which data was included for all time points in the 2021 SID reports. Aggregated data reflects both PEPFAR Country Programs and PEPFAR Regional Programs.

The Unintended Consequences of PEPFAR

The literature suggests that PEPFAR has resulted in a series of unintended consequences. First, according to Harmon (2015), PEPFAR expanded the role of markets in the health sector in recipient countries through the introduction of multiple, new, high-dollar funding mechanisms (e.g., contracts and cooperative agreements). This position gave PEPFAR outsized control and exacerbated dependencies, as the market became simultaneously donor-led and donor-dependent. Additionally, the market became the guiding principle for health policy decisions, resulting in skewed health policy and planning around HIV/AIDS in recipient countries (Harman, 2015).

Second, PEPFAR’s funding, technical assistance, and diplomatic clout influenced a preoccupation with vertical disease-based interventions, to the detriment of wider health system-

strengthening activities in recipient countries, likely contributing to the fragmentation and distortion of the health sector (Harman, 2015). According to some scholars, PEPFAR has also led to the formation of new institutions, established a new level of administrative bureaucracy, and created a non-health specialist management accountancy class within the health sector (Harman, 2015; Long, 2017).

PEPFAR's role as donor and its relationship to the market has meant that, for all of its efforts to generate internal and external stakeholder consensus and buy-in, competition rather than collaboration has marked its implementation (Harman, 2015). PEPFAR created competition among and between internal United States government USG agencies, as well as international and local health services organizations such as academic institutions, non-governmental organizations, and faith-based organizations. Additionally, PEPFAR's profile and funding resulted in the co-opting of civil society organizations (Harman, 2015).

By establishing new institutions and fostering competition, PEPFAR has altered the institutional structure in recipient countries, allowing stakeholders to circumvent constitutionally- and legislatively-established governance processes by disrupting principle-agent dynamics (Dionne, 2018; Long, 2017). In what Nora Kenworthy (2017) refers to as the politics of reciprocity, PEPFAR has also altered the relationships between health institutions, country governments, and their citizens.

The preceding examples of the unintended consequences of PEPFAR demonstrate that, in addition to influencing HIV treatment outcomes, PEPFAR has also affected the institutional structures in the countries in which it operates. The impacts of these shifts are unknown, both generally and in terms of recipient countries' ability to assume control of their national HIV programs and achieve or sustain HIV epidemic control.

The U.S. President's Emergency Fund for AIDS Relief Design

This project posits that PEPFAR's operational model may be artificially influencing the decentralization structures in the countries in which it operates, to a level that impedes the ability of recipient countries to assume control of their national programs and maintain HIV treatment gains made under PEPFAR. To understand the operational model of PEPFAR, it is necessary to understand its original intent and design.

Following the end of the Cold War, the U.S. foreign policy model was focused on hard power (i.e., military might) (Bass, 2021). In the early 2000s, the increasing need to address the global HIV pandemic, which had been neglected by previous presidential administrations, presented the George H.W. Bush Administration with a unique opportunity to both deliver a global act of mercy, in line with the conservative religious values espoused by the President, and reshape the U.S. foreign policy paradigm from a hard- to a soft-power approach (Bass, 2021). This soft-power approach, it was theorized, would better position the U.S. to assert global influence through economic growth and foreign aid (Bass, 2021).

PEPFAR was designed to operate as a bilateral program, using a government-to-government approach (Donnelly, 2012), and conceptualized as a better-funded counterbalance to the nascent UN Global Fund For HIV, Tuberculosis, and Malaria program, or The Global Fund (Varmus, 2013). The Global Fund, which launched in 2002, operates on a multilateral model, whereby a collective of multi-country governments administers pooled resources, similar to programs administered through the United Nations agencies. In the multilateral aid model, the emphasis is on inputs (i.e., dollars), leaving little room for administrative or technical control by a single donor country (Bass, 2021). For the Bush Administration, a bilateral model was preferable, because it allowed the donor government agencies responsible for administering the

program components to work directly with the central or national government of the recipient country. Further, a bilateral program would allow the U.S. government control over programmatic outcomes and facilitate shared accountability for results between the United States and the recipient countries, elements that the Bush Administration felt were lacking from The Global Fund (Bass, 2021).

To take full advantage of the benefits of the bilateral donor approach (control over outcomes, mutual accountability, and soft-power leverage), PEPFAR's administrative structure, comprising multiple federal agencies, was centralized into a hierarchical model. At the top, a single federal official, the PEPFAR ambassador, headed a single federal unit, the Office of the Global AIDS Coordinator (OGAC) (Varmus, 2013), which was strategically placed at the Department of State. This positioning within the State Department provided PEPFAR, a humanitarian aid program, with significant diplomatic leverage (Bass, 2021). The bilateral aid model, combined with the diplomatic power of the State Department, enabled the U.S. government to exact the influence that was needed to produce outcomes, ensure accountability to the American taxpayers, and conduct soft-power influence (Bass, 2021). Under the direction of the PEPFAR Ambassador and OGAC, PEPFAR created centralized in-country administrative structures, referred to as PEPFAR Country Teams, within the U.S. Embassies of the recipient countries (Bass, 2021). PEPFAR country teams, centralized under the Deputy Chief of Mission reporting directly to the in-country U.S. Ambassador, were comprised of the U.S. agencies supporting in-country PEPFAR efforts (i.e., The U.S. Department of Health and Human Services, The U.S. Agency for International Development, the U.S. Department of Defense, and the U.S. Peace Corps). These teams were responsible for administering the financial and technical support required by the program.

At the time of PEPFAR's development, President Bush's PEPFAR architects were in a race against the activists who preferred The Global Fund to Fight AIDS, Tuberculosis, and Malaria and alternative competing global AIDS response legislation being developed within the U.S. Congress (Donnelly, 2012). PEPFAR planning meetings were kept small and engaged primarily presidential aides, legislators, and public health and medical professionals (Bass, 2021). These efforts focused on securing congressional support, ensuring a reasonable, supportable five-year budget, and designing the service delivery model.

In terms of framework, PEPFAR was developed within a biomedical/behavioral paradigm, as a technical response to address the biomedical and behavioral causes of the disease. There is no information in the original accounts of the development of PEPFAR to suggest that the long-term absorption capacity of recipient governments influenced program design (Bass, 2021; Donnelly, 2012; Lefkowitz, 2009; Varmus, 2013). Additionally, none of the existing literature describing the genesis of PEPFAR suggests that substantive forethought was given to how the structures and systems established through PEPFAR would address the structural drivers of the HIV epidemic or align with or influence the existing political, health, or other institutional structures within recipient countries (Bass, 2021; Donnelly, 2012; Lefkowitz, 2009; Varmus, 2013).

There is little doubt that PEPFAR presented a turning point for the global HIV/AIDS epidemic. However, beyond the mention of potentially using PEPFAR as a new foreign aid model and a soft-power conduit, PEPFAR's architects did not consider the longer-term, cross-sectoral impacts of a 20-year, bilateral HIV emergency response program with a strong, centralized, in-country presence on the structural and policy landscape of recipient countries. Meanwhile, evidence suggests that neglecting to harmonize donor and country programs can

undermine country health efforts, leading to negative unintended consequences (Oliveira Cruz & McPake, 2011). It is becoming increasingly apparent, through both the literature and the challenges facing PEPFAR sustainability efforts, that this lack of planning foresight has introduced myriad unintended consequences, which could inhibit the ability of LMICs to assume control of their own national HIV response and maintain or achieve epidemic control in the absence of PEPFAR. Increased focus on the political and governance challenges associated with implementing HIV responses in LMICs is important as global donor programs seek to transition from service delivery to technical assistance and sustainability (Khalid & Fox, 2019).

Political Determinants of Health

Over the past 15 years, academic and practitioner reporting have increasingly linked the success of public health initiatives to political decision-making. Following the publication of the "Alternative World Health Report" in 2005, there has been increasing global focus on the role that political factors play in shaping global health outcomes (Kickbusch, 2005), and a growing body of research has studied the impact of political factors, broadly defined, on population health (Kickbusch, 2015). This body of empirical and theoretical work, referred to as "political epidemiology," primarily seeks to identify the political institutions and factors that facilitate or impede public health decision-making and action (Mackenbach, 2014). These conditions, institutions, and factors are collectively referred to as the "political determinants of health" (Mackenbach, 2014).

The findings from theoretical and empirical political epidemiology research foster a better understanding of the political determinants of health, which, in turn, can be used to strengthen the ability of national governments and international organizations to promote health

within the political arena, address health policy gaps, and implement collaborative approaches to policymaking across sectors to improve global health (Mackenbach, 2014).

Meanwhile, a small but growing body of evidence links political institutions with population-level health outcomes. Findings from the theoretical and empirical literature suggest that countries with more democratic governments are associated with lower rates of mortality, healthier behaviors, and better self-rated health than more authoritarian governments (Barnish et al., 2018; Beckfield & Krieger, 2009; Kickbusch, 2005; Kickbusch, 2015; Lake & Baum, 2001; Lena & London, 1993; Muntaner et al., 2011). However, there is limited empirical data to demonstrate how individual democratic principles influence specific disease environments and shape government responses to epidemic diseases (Troesken, 2015). Contrary to normative expectations, some scholars and studies suggest that certain democratic principles, such as decentralization, may lead to heterogeneity in laws, policies, and practices, which may negatively impact public health outcomes (Frasca et al., 2018; Jiménez-Rubio & García-Gómez, 2017; Martyn, 2004; Troesken, 2015).

Rondinelli (1986) defines decentralization as “...a process by which administrative, fiscal, and decision-making activities and authorities are distributed or delegated away from a central government to sub-national governments- including local governments, civil society, and the private sector.” Because the literature provides no standard definition for decentralization, this study selected the Rondinelli definition to help frame the concept; this explanation includes a clear description of the public functions associated with decentralized authority and responsibility and clarifies its recipients.

Since the 1970s, decentralization, as an ideological principle, has been positively associated with democracy and viewed as a desirable political objective (Rondinelli & Nellis,

1986). Decentralization policies have become the global standard, rooted in the normative assumption that moving decision-making activities and authorities “closer to the people” will promote the creation or strengthening of democracy and good governance and enhance accountability in service provision (Faguet et al., 2015; Ivanyna & Shah, 2014; Ofoulhast-Othamot, 2018).

International aid organizations such as the International Monetary Fund, World Bank, United Nations, and the World Health Organization have integrated decentralization requirements into their development strategies and prioritized decentralization activities and health system reforms as a conditionality of aid for LMICs more than 40 years (Castles, 1999; Cobos Muñoz et al., 2017; Dwicaksono & Fox, 2018; Fedelino & Ter-Minassian, 2009; Goel et al., 2017; Mills et al., 1990; United Nations Human Settlements Programme, 2009). Just as political decentralization activities and policies look to create or strengthen democracy and good governance (Faguet et al., 2015; Ivanyna & Shah, 2014; Ofoulhast-Othamot, 2018), health sector decentralization activities and policies are designed to leverage administrative, fiscal, and political functions to improve health service provision (Cobos Muñoz et al., 2017; Dwicaksono & Fox, 2018).

Health system decentralization, or that specific to the health sector, can be defined as the transfer of formal responsibility and power to make decisions regarding the management, production, distribution, and/or financing of health services, usually from a smaller to a larger number of geographically or organizationally separate actors (Saltman et al., 2006). In a fully decentralized health system, local governments, rather than the national or federal government, are responsible for healthcare for their residents. As with government decentralization, there are numerous purported benefits of health sector decentralization, including improved efficiency,

service delivery innovation, increased equity, improved infrastructure, increased accountability, and better health outcomes (Maharani & Tampubolon, 2014; Saltman et al., 2006).

According to Jimenez-Rubio and Garcia-Gomez, lasting benefits from health sector decentralization are most likely to accrue when full political and fiscal decentralization have been realized across all sectors of government (2017). This finding suggests an important relationship between government and health sector decentralization. The wider empirical and theoretical landscape surrounding the relationship between decentralization and health outcomes remains mixed, and will be further explored in Chapter 2.

With the relationship between decentralization and health outcomes in mind, it seems reasonable to conclude that development programs that exert an outsized influence on health system reforms may be more effective if the funders and implementors understand 1) the degree of decentralization within the recipient country, 2) how their program objectives or resulting reforms may impact decentralization in the country, and 3) how to align their program policies and practices with the recipient country's existing decentralization strategies and policies. In order to address this uneven understanding, this project looks to test the relationships between decentralization and health outcomes within the context of PEPFAR.

Conceptual Framework

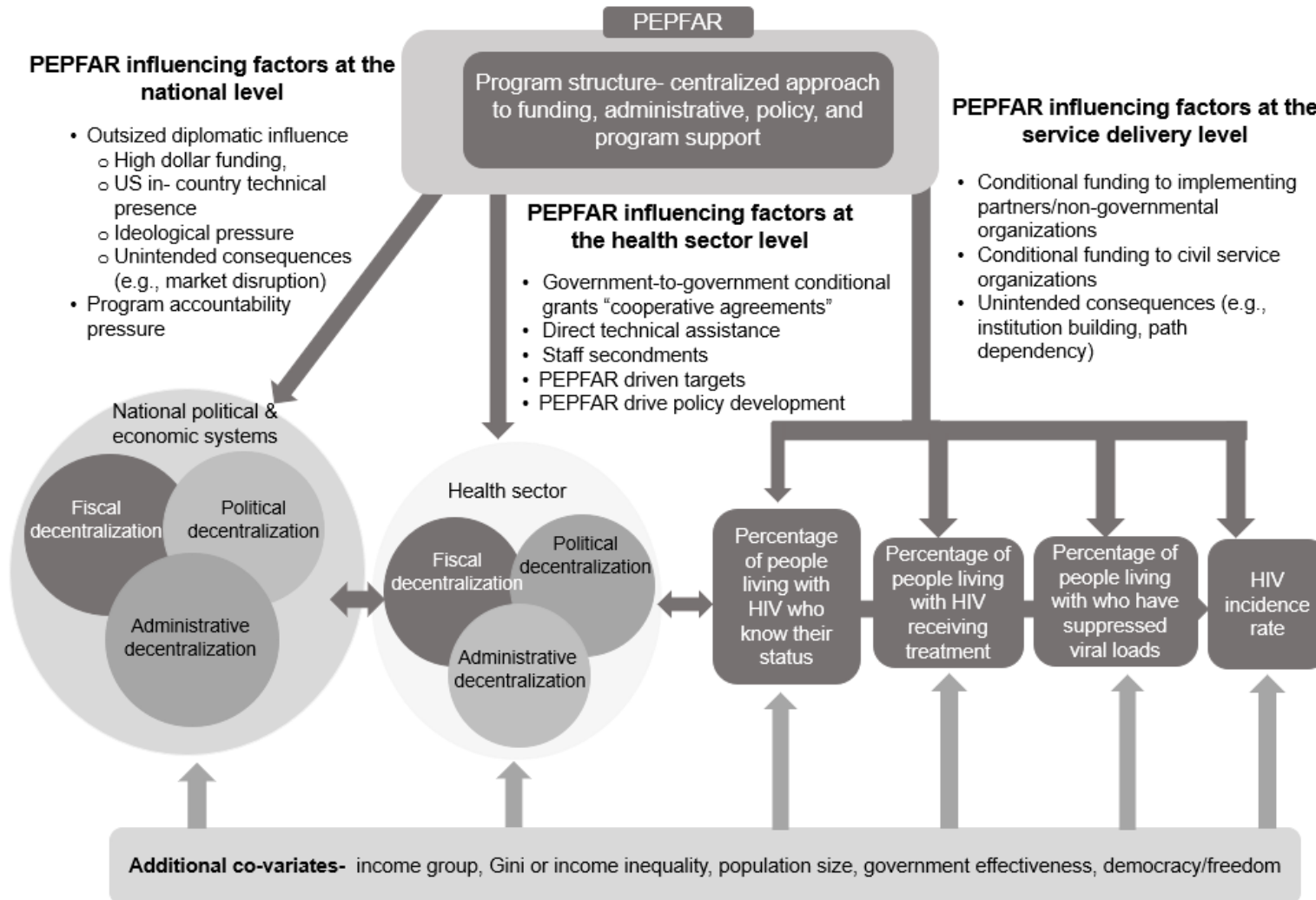


Figure 1: Conceptual Framework

Figure 1 represents the proposed relationship between decentralization (government and sectoral decentralization), PEPFAR, and HIV outcomes, and tracks the process through which PEPFAR programs may be exerting a centralizing influence on existing decentralization structures in the countries in which they operate. This conceptual framework highlights the three types of decentralization that emerge from the political and economic systems at the country level: political decentralization, administrative decentralization, and fiscal decentralization. These relationships suggest that national-level decentralization structures influence those at the sectoral level, and that the three decentralization types are mirrored within the health sector.

The above framework depicts four channels through which PEPFAR, with its centralized approach to funding, administrative, policy, and program support, influences HIV outcomes while simultaneously challenging existing decentralization structures in recipient countries. Figure 1's bi-directional arrows suggest that PEPFAR's centralized approach could influence the existing decentralization structures at both the health-sector and national levels.

This project seeks to build on the counter-normative argument suggesting that decentralization, a political and economic institution closely tied to democracy and freedom, may be antithetical to the control of infectious disease outbreaks such as HIV. Assuming this argument holds true, the author contends that LMICs' current success with HIV epidemic control may be a result of PEPFAR programs' centralizing influence, imposed alongside, and, perhaps, in opposition to, ongoing decentralization efforts at the country-level and within the health sector. In other words, PEPFAR may be masking the negative relationship between decentralization and HIV epidemic control by centralizing control of HIV programs at the national level.

One of the defining characteristics of PEPFAR, as outlined through this introduction, is its establishment as a bi-lateral funding mechanism. This means that, through PEPFAR, the United States government provides funding directly to the national government in recipient countries. Simultaneously, PEPFAR places strict conditions on this funding and sets global- and national-level policy and programmatic priorities. This government-to-government approach leaves more decentralized country governments with limited options for sub-national funding other than conditional grants, a primary indicator of decentralization. If PEPFAR, either explicitly or implicitly, requires national governments to use conditional grants when funding HIV response activities at sub-national levels, it is, in effect, imposing a centralizing tendency. Because bilateral, government-to-government funding has been a defining characteristic of PEPFAR and unconditional grants are a key indicator of decentralization, this project will focus on fiscal decentralization as the primary independent variable of interest. However, it will also explore and address other types of decentralization.

Project Aim

The aim of this mixed-methods study is to determine whether decentralized LMICs have worse HIV outcomes than more centralized LMICs, and if the presence of PEPFAR improves or worsens these outcomes. This goal, rooted in the counter-normative argument that decentralization can inhibit infectious disease control, involves the following objectives:

1. Establish the nature of the relationship between fiscal decentralization and the HIV treatment cascade in low-and middle-income countries.
2. Determine if PEPFAR moderates the relationship between fiscal decentralization and the HIV treatment cascade in low-and middle-income countries.

3. Explore the effects of administrative, and political decentralization on the HIV treatment cascade in low- and middle-income countries and compare these effects to those between fiscal decentralization and the HIV treatment cascade in low- and middle-income countries.

Significance

Identifying and understanding the relationship between decentralization and the HIV treatment cascade, and the role that PEPFAR plays in moderating this relationship, may reveal insights critical to future policy and programmatic opportunities. With this improved understanding and informed policymaking, PEPFAR can better support recipient countries as they increase efforts to assume ownership of their national HIV response and seek to achieve and sustain HIV epidemic control. The additional clarity on the relationship between political institutions and epidemic diseases gleaned from this project may inform the future research agenda on this topic, leading to policy and programmatic efforts to strengthen the effectiveness and efficiency of epidemic and outbreak response beyond HIV.

CHAPTER 2: LITERATURE REVIEW

Decentralization

The role of a strong centralized state in effective governance has been a topic of debate for centuries, with evidence of the concept of decentralization, or the distribution of power away from a central state toward local bodies, dating as far back as the Magna Carta of 1215 (Pollitt, 2007). Consensus holds that decentralization was established and documented as a formal political strategy in the 18th-century legislative reforms emerging from the French Revolution (Schmidt, 1991). The practice of government decentralization entered more broadly into the public administration discourse during the 19th century, as centralists and decentralists in both Europe and America engaged in written and verbal debates around which institutional approach, centralization or decentralization, was more beneficial to the state (Pollitt, 2007).

The second half of the 20th century witnessed the end of both colonialism and communism, two systems that placed a high value on the strength of strong central state power. During this neo-colonial era, decentralization gained new impetus based upon the belief that it could "solve numerous political, administrative, social, and economic ills" plaguing new and emerging governments (Ofoulhast-Othamot, 2018). Since the 1970s, decentralization policies and efforts have been supported by donor and development agencies as a vehicle for democratic reforms and as a facilitator of globalization (Boex, 2015; Ivanyna & Shah, 2014; Ofoulhast-Othamot, 2018; Poteete et al., 2014).

Without a standard definition of decentralization in the literature, that of Rondinelli and Nellis (1986) underpins modern conceptions across different disciplines, including comparative

politics, economics, public administration, and political science (Boex, 2015). Rondinelli and Nellis (1986) define decentralization as the:

...[T]ransfer of authority and responsibility for planning, management, resource-raising and allocation and other functions from the central government and its agencies to field units of central government ministries or agencies, subordinate units or levels of government, semi-autonomous public authorities or corporations, or non-governmental or voluntary organizations.

The theoretical and empirical literature describes multiple potential benefits of decentralization linked to democracy, including increased citizen participation (Faguet et al., 2015), improved efficiency and quality of public service delivery (Ofoulhast-Othamot, 2018), increased accountability of public officials (Pollitt, 2007), increased stability (Duncan, 2007), improved perceptions of government performance (Goel et al., 2017), and stronger economic growth (Arzaghi and Henderson, 2005). A recent quasi-experimental study conducted in Honduras examined the association between decentralization and cooperation among public officials, concluding that decentralization is positively associated with democratic governance (Molina-Garzón et al., 2022).

A review of the empirical literature reveals a relationship between democracy and health outcomes at the population level. Barnish et. al. (2018) conducted a systematic review of 258 studies on the relationship between political features, including democracy, and population health outcomes. The authors concluded that democracy is generally positively associated with population health, a finding that is supported by several cross-national panel analyses (Bollyky et al., 2019; Krueger et al., 2015; Lena & London, 1993; Matsuura, 2019; Muntaner et al., 2011; Patterson & Veenstra, 2016).

Scholars have established that the scale-up of national HIV programs in low- and middle-income countries (LMIC) requires active participation of state governments (Gore et al., 2014). Bollyky (2019) found that HIV-free life expectancy at 15 years improved significantly (by 3% after 10 years) in countries after they transitioned to democracy. A study conducted in sub-Saharan Africa in 2016 found a negative relationship between geopolitical factors associated with democracy (i.e., political participation) and HIV prevalence, suggesting that an absence of democratic institutions in LMICs can worsen an HIV epidemic (Bollyky, 2019)). This conclusion is supported by the comparative analysis conducted in China by Ruger (2005), who reviewed the Chinese government's approach to the 1958-1961 Chinese Famine and the 2003 SARS outbreak to surmise that implementing democratic institutions and provision more broadly would enable China to control their burgeoning HIV/AIDS epidemic (Ruger, 2005). More recently, a cross-national study using panel data from 2004-2007 in 143 countries showed that democracy increased access to treatment for HIV/AIDS in LMICs (Justesen, 2012).

The findings described in this section suggest that democratic countries generally have better population-level outcomes, including HIV outcomes, than non-democratic countries: However, less is known about the relationship between state structures and individual-level HIV outcomes (van der Windt & Vandoros, 2017). Given that decentralization is an important feature of democratic governance, it logically holds that decentralization would lead to positive health outcomes, including HIV outcomes.

Measuring Decentralization

Measurement of decentralization is challenging and remains an active area of research: the concept and its elements are broad, and there is no widely accepted standard definition. Adding complexity to this measurement challenge is the fact that different authors propose

different classification systems and typologies for decentralization. For example, Rondinelli and Nellis (1986) propose a classification of four different types of decentralization rooted in a traditional public administration framework, including delegation, de-concentration, devolution, and privatization. Triesman (2002), meanwhile, suggests a six-part typology rooted in a political and economic framework consisting of vertical decentralization, decision-making decentralization, appointment decentralization, electoral decentralization, fiscal decentralization, and personnel decentralization. It is also important to note that decentralization can represent a static state of being or a dynamic process, an important consideration for measurement efforts (Triesman, 2002).

Authors of various decentralization-based studies have utilized differing definitions, typologies, and perspectives depending on the purpose and objectives of their research or thought exercise. The literature proposes three predominant approaches to measuring decentralization. In the first, researchers develop study-specific measures that represent the decentralization type of interest for which researchers can extract readily available data, either through country-specific records or through pre-existing global databases (Abdelhak et al., 2012). The second approach involves the application of decentralization indices, or “rankings classifying states and sub-state units according to their degree of territorial autonomy through a system of measurement and scoring” (Harguindéguy et al., 2021). In the third approach, established by Bossert (1998), the use of a decision-space framework stresses the import role that decision making autonomy plays in facilitated gains from decentralization efforts, primarily in the health system. A review of current literature suggests that decision space analyses are most often used to assess decentralization as a process, while individual indicators and indices are often used to assess decentralization as a static state.

In their 2021 literature review, Harguindéguy and colleagues (2021) identified and compared what they defined as the 25 main indices available for measuring the degree of decentralization within and across countries, based on the definition of decentralization, unit of analysis, geographic coverage, variables, score and weighting applied, method of data collection utilized, and validity and reliability. There was heterogeneity among the indices, caused in part by the unit of analysis. Broadly, one index focused exclusively on the regional level (Hooghe et al., 2016), seven focused on the local level (Advisory Commission on Intergovernmental Relations, 1981; Ferreira do Vale, 2015; Fleurke & Willemse, 2006; Ivanyna & Shah, 2014; Ladner et al., 2016; Sellers & Lidström, 2007; Wolman et al., 2008), 12 addressed sub-state units as a whole (Arzaghi & Henderson, 2005; Brancati, 2006; Castles, 1999; Gerring & Thacker, 2008; Lane & Ersson, 1999; Lijphart, 1999; OECD, 2015; Panizza, 1999; Rodden, 2003; Schneider, 2003; Sioroff, 2013; Woldendorp et al., 2011), and five included multiple units of analysis (e.g., state and local level) (BAK Basel Economics, 2009; IMF, 2013; Stegarescu, 2005; Stephens, 1974; Triesman, 2002). The unit of analysis is an important consideration in index design; suitability will depend upon the application and intent of the analysis.

Three dimensions of decentralization have been proven to be orthogonal and valid through factor analysis: political, fiscal, and administrative (Schneider, 2003). Of the indices included in the Harguindéguy et al. (2021) review, five measured fiscal decentralization only (IMF, 2013; OECD, 2015; Panizza, 1999; Rodden, 2003; Stegarescu, 2005), four measured political decentralization only (Brancati, 2006; Gerring & Thacker, 2008; Lijphart, 1999; Sioroff, 2013), five measured a combination of two of the three dimensions (Castles, 1999; Fleurke & Willemse, 2006; Stephens, 1974; Triesman, 2002; Woldendorp et al., 2011), and 11 measured all three dimensions (Advisory Commission on Intergovernmental Relations, 1981; Arzaghi &

Henderson, 2005; BAK Basel Economics, 2009; Ferreira do Vale, 2015; Hooghe et al., 2016; Ivanyna & Shah, 2014; Ladner et al., 2016; Lane & Ersson, 1999; Schneider, 2003; Sellers & Lidström, 2007; Wolman et al., 2008). None of the indices included in this review (Harguindéguy et al., 2021) measured only administrative decentralization. Seven covered a one-year time scale (Advisory Commission on Intergovernmental Relations, 1981; BAK Basel Economics, 2009; Ivanyna & Shah, 2014; Sellers & Lidström, 2007; Siaroff, 2013; Triesman, 2002; Wolman et al., 2008) and 12 reported a single measurement (Advisory Commission on Intergovernmental Relations, 1981; Fleurke & Willemse, 2006; Gerring & Thacker, 2008; Ivanyna & Shah, 2014; Lane & Ersson, 1999; Lijphart, 1999; Sellers & Lidström, 2007; Siaroff, 2013; Stephens, 1974; Triesman, 2002; Woldendorp et al., 2011; Wolman et al., 2008).

Of the 25 indices reviewed, most lacked global coverage: only four provided values for more than 100 countries (Gerring & Thacker, 2008; IMF, 2013; Ivanyna & Shah, 2014; Siaroff, 2013). Of these, only one, Ivanyna and Shah (2014), covered all of the 25 countries funded by PEPFAR that completed both a Country Operational Plan and an annual sustainability index dashboard (SID) in 2019. Harguindéguy and colleagues (2021) reported on the existence of validity results in the main citations associated with each of the indices, with Ivanyna and Shah (2014) being one of the 19 indices lacking such computed results. While it is desirable for decentralization indices to have demonstrated valid results, those that do tend to cover the most information-rich countries and exclude low and middle-income countries.

In 2014, Ivanyna and Shah published their decentralization index, which was developed to assess the “closeness of a government to its people.” Their index alone utilizes tiers of local government, including its lowest level, to determine decentralization ranking. The aggregated decentralization index, which assigns a value to 182 countries is comprised of three sub-indices:

administrative, fiscal, and political decentralization. Table 2 below highlights the definitions and measures that were included in the Ivanyna and Shah (2014) indices, which represent one point in time and were collected in 2005. Qualitative and quantitative literature in empirical and theoretical studies that focus on development and fiscal decentralization favor the Ivanyna and Shah index (Haldenwang, 2010; Mascagni, 2016; Oto-Peralías et al., 2013). Examples of studies where the Ivanyna and Shah (2014) fiscal decentralization index was used in the context of low- and middle-income countries include a qualitative study assessing revenue mobilization at the local level in Ghana (Abiire et al., 2020), and a quantitative longitudinal study exploring the moderating role that natural resources play in the relationship between fiscal decentralization and corruption in Indonesia (Ratmono, 2019). Further, the 2013 study by Oto-Peralias et. al. using the Ivanyna and Shah (2014) fiscal decentralization index found that increased fiscal decentralization was associated with less corruption in the most corrupt high-income countries (Oto-Peralías et al., 2013); other work has associated increased fiscal decentralization with increased corruption in Indonesia (Oto-Peralías et al., 2013; Ratmono, 2019). These studies featured mixed findings.

Table 2: Ivanyna and Shah (2014) Decentralization Indices Definitions and Measures

Aggregated Decentralization “The ‘closeness’ of a government to its people”	Administrative Decentralization “The ability of sub-national and local governments to regulate their own functions and to hire and fire and set terms of employment”	Fiscal Decentralization “The level of fiscal autonomy afforded to sub-national and local government bodies”	Political Decentralization “The degree to which the sub-national and local governments are governed by their own citizens, home-rule status”
The relative importance of local government	Human resource policies	Fiscal gap	Legislative elections
Security of local government	Employment metrics	Taxation	Executive elections
Administrative decentralization measures	Regulation authorities	Unconditional transfers	Direct democracy provisions
Fiscal decentralization measures		Expenditure autonomy	
Political decentralization measures		Borrowing Freedom	

Decentralization and Health-related Outcomes

Dwicaksono and Fox (2018) conducted a systematic review of the literature published between 2000 and 2016 to explore whether decentralization processes have improved health system performance and outcomes in LMICs. The authors used established search terms to identify 814 potential articles, and reviewed and applied exclusion criteria to yield 16 articles in their final review. The outcome measures of the 16 included studies were grouped into three categories and related measurements: health system inputs (three studies), health system performance (seven studies), and health outcomes (seven studies). Results regarding the

empirical effects of health system indicators were mixed. The strongest evidence of a link between decentralization and health came from the studies that included measures of health system performance (e.g., service delivery) and health outcomes (e.g., immunization status), while, in studies focusing on health system inputs such as budget shares and public health spending, the link was less certain.

Cobos Muñoz et. al. (2017) conducted a literature review to explore the effects of decentralization on health systems in LMICs, using 54 articles describing studies across 26 countries published up until May 2015 (11 qualitative studies, 28 quantitative studies, and 15 mixed methods studies). Like Dwicaksono and Fox (2016), the authors found mixed results regarding the effects of decentralization on a range of health-related indicators, including mortality, financing, governance, medicine and equipment, health information, human resources, and service delivery. The authors found that the positive effects of decentralization were more often identified in quantitative studies that focused on mortality, while positive and negative relationships were observed between decentralization and the other indicators in the qualitative literature (Cobos Muñoz et al., 2017).

The Effect of Decentralization on Health Outcomes

The current literature review reinforces the findings of that by Cobos Munoz et. al. (2017): quantitative literature is more likely to support a positive association between decentralization and health outcomes, while mixed-methods and qualitative studies suggest a more complicated relationship. Recent longitudinal studies conducted across and within Organization for Economic Cooperation and Development (OECD) countries have found a positive association between decentralization and life expectancy, infant mortality, and infant and neonatal mortality (Cavalieri & Ferrante, 2016; Dougherty et al., 2022; Jiménez-Rubio &

García-Gómez, 2017). Dougherty and colleagues (2022) conducted a panel regression in 26 OECD countries on data reported for 2000-2015. The findings suggest that the relationship between fiscal and administrative decentralization and life expectancy is strongest in countries that have moderate decentralization rather than low or high levels (Dougherty et al., 2022). Using a longitudinal panel regression model on data collected from 20 regions in Italy from 1996-2012, Cavalieri and Ferrante (2016) demonstrated that increased fiscal decentralization is associated with lower infant mortality, concluding that the effect was strongest in poorer regions and weaker in wealthier regions. Using data from 50 Spanish provinces between 1980 and 2010, Jimenez-Rubio and García-Gómez (2017) looked at the effect of fiscal decentralization on infant and neonatal mortality. While the study found a beneficial effect of decentralization in decentralized regions, the authors concluded that the lasting benefit of decentralization accrued only in fully decentralized regions, which, they pointed out, were also the wealthiest (Jiménez-Rubio & García-Gómez, 2017). This finding is contrary to that of Cavalieri et. al. (2016), who highlighted that, in Italy, the strongest effect between decentralization and infant mortality was observed in poorer regions.

In addition to having a positive effect on infant mortality in OECD countries, there is evidence that decentralization has a positive effect on infant mortality and other health outcomes in LMICs (Rotulo et al., 2020). In a cross-sectional ecological analysis across all countries between the years 1970-1995 (Robalino et al., 2001), the authors found that decentralization was consistently associated with lower mortality rates, measured as deaths per 1,000 live births. The benefits from fiscal decentralization, they concluded, facilitated political rights and may be a mechanism to improve health outcomes in countries and regions with high corruption (Robalino et al., 2001), suggesting that decentralization is an important policy intervention in LMICs.

A 2004 ecological cross-sectional time-series study looking at the relationship between fiscal decentralization and immunization services from 1980-1997 across 140 LMICs found that decentralization has different effects in low- and middle-income countries (Khaleghian, 2004). In the low-income group, decentralized countries had higher immunization coverage rates than centralized countries (8.5%). Middle-income countries demonstrated the opposite relationship, whereby centralized middle-income countries had higher immunization coverage rates (5.2%). This study also found that development assistance modified the relationship between decentralization and immunization outcomes by reducing gains from decentralization in low-income groups (Khaleghian, 2004).

Soto et. al. (2012) conducted a cross-sectional time-series study looking at the relationship between decentralization and infant mortality rates across 1080 Colombian municipalities over 10 years. The authors used fixed effect regression with robust errors to demonstrate that decentralization decreased infant mortality rates. The model indicated that the effect between decentralization and decreased infant mortality rates was stronger in non-poor municipalities than in poor ones.

Not all studies highlight a positive association between decentralization and health outcomes. Using a multi-level regression analysis to estimate the effects of fiscal decentralization on childhood immunization status in Indonesia, Maharani and Tampubolon (2014) found that fiscal decentralization was not associated with child immunization, though they did uncover a positive association between child immunization status and the number of village health centers. The study concluded that Indonesia should focus on decentralizing service delivery, as opposed to decentralizing financial functions, as increasing the number of local clinics was more likely to improve outcomes (Maharani & Tampubolon, 2014). A simultaneous

equation model, on time series data from 2002-2012 across 23 Chinese provinces, examined the impact of fiscal decentralization on perinatal mortality, finding a negative direct and indirect effect (Hao et al., 2021).

The Effect of Decentralization on the Health System

Atkinson and Haran (2004) conducted a mixed-methods study in Brazil, collecting qualitative data from 100 women and quantitative data from three health centers in each of the 45 municipalities, representing different stages of decentralization. The authors found that while decentralization did not significantly improve health system performance in Brazil, it was not associated with worse performance (Atkinson & Haran, 2004). They concluded that good health system management practices facilitated decentralization, as opposed to decentralization facilitating good health system management practices (Atkinson & Haran, 2004).

Atkinson and Haran (2004) did observe increased utilization of preventive care associated with decentralization, although these findings were not robust enough to withstand statistical testing. These findings align with those of Regmi et. al. (2010), who conducted in-depth interviews and focus groups in four primary health institutions in Nepal. The qualitative findings indicate that decentralization was positively associated with increased access to and utilization of services, as well as improved service delivery (Regmi et al., 2010).

As highlighted by the previous two studies described in this section, the literature exploring the relationship between decentralization and the health system is primarily mixed method or qualitative. Much of the related literature relies on the decision space analysis approach established by Thomas Bossert (Bossert, 1998). In an early decision space analysis of decentralization in the health systems in Ghana, Zambia, Uganda, and the Philippines, the authors found significant variation across countries in terms of the types and degrees of

decentralization being implemented. The Philippines implemented decentralization through devolution, which resulted in the widest range of choices, while Ghana implemented health system decentralization through a delegation approach, which provided the least amount of decision space (Bossert & Beauvais, 2002). This study highlighted that considerable variation exists within and across LMICs as to the type and degree of decentralization being implemented within the health sector. A 2011 study conducted in Pakistan also identified similar variations in the health sector of that country, and concluded that health systems focus on identifying areas where synergies can be leveraged to build its institutional capacity (Bossert & Mitchell, 2011).

A 2017 qualitative study conducted in Kenya's Kilifi County dove more deeply into the relationship between devolution and its impact on health sector planning and financial management. The authors used key informant interviews, observations, and document reviews to examine the effect of devolution on health sector planning, budgeting, and overall financial management at the county level. The authors found that devolution allowed for local-level prioritization and community involvement in health sector planning and budgeting. As a result, it created opportunities for equity in local-level resource allocation. However, limited local capacity inhibited the ability of facility staff to assume devolved functions, which may have resulted in financial management responsibilities being recentralized to a higher level (Tsofa et al., 2017).

A decision space analysis conducted in Zambia in 2003 concluded that while decentralizing in the Zambian health system did not impact service utilization, it did allow districts to make internal decisions regarding the allocation of resources (Bossert et al., 2003). More recent decision space studies in the literature suggest a positive correlation between decentralization and service delivery, as well as human resources for health, in Uganda, India,

and Ghana (Mansour et al., 2022; Seshadri et al., 2016; Sumah & Baatiema, 2019). Meanwhile, Chen et. al. (2021) caution that although decentralization can increase facility autonomy and managerial performance, it may not be sufficient for improving facility-wide performance.

A 2019 cross-sectional qualitative study conducted in South Africa found that front-line workers were not included in decision-making related to the implementation of the Ideal Clinic Realization and Maintenance Program (Muthathi et al., 2020). This oversight led to participants reporting narrow decision space on critical areas related to their job functions, such as the availability of medicines and equipment. The authors conclude that the involvement of frontline workers is critical to supporting successful decentralization efforts within the health sector (Muthathi et al., 2020). Across decision space studies conducted in Switzerland, Canada, Germany, Brazil, South Africa, Mexico, and Nigeria, Marchildon and Bossert (2018) observed that 1) decentralization covered a wide range of experience across countries and 2) even in the most decentralized health systems, functions primarily related to funding continued to remain centralized, suggesting that continued dependence on financial transfers from a central body will reduce decision space at lower levels.

Decentralization and HIV-specific Outcomes

A 2011 paper by Zhang et. al. described a study undertaken to assess the decentralized service provision system for people living with HIV/AIDS (PLWHA) in three rural counties of two provinces in China. The findings suggest that decentralization of HIV treatment and care to the local level is an effective strategy for reaching PLWHA, and that decentralization has lowered barriers to health access for PLWHA in rural areas (Zhang et al., 2011). A 2019 systematic review of post-1996 literature conducted by Haghghat, Steinert, and Culver found

that decentralized care may also result in, at least, equivalent rates of retention in care and mortality for HIV-positive youth (ages 10-24) living with HIV in resources-limited settings.

Loubiere et. al. (2009) conducted a cross-sectional study to identify the factors related to non-access to ART in six of the ten provinces in Cameroon between 2006-2007. A quantitative survey was administered to a representative sample of people living with HIV seeking HIV care, revealing that individuals who had to utilize HIV care and treatment services at central hospitals were less likely to have access to ART than those doing so at district hospitals. These findings align those from Fayorsey et. al. (2013), which demonstrated that primary health facilities, as opposed to secondary and tertiary facilities, are associated with lower loss to follow-up and lower mortality among children younger than 15 living with HIV and receiving HIV treatment across 274 public facilities in Kenya, Lesotho, Mozambique, Rwanda, and Tanzania from January to March 2010.

In a cross-sectional study survey administered to 1016 patients at seven hospitals and health centers across three epicenters or metropolitan areas in Vietnam, multivariate analysis found that patients receiving services at provincial and district health centers reported significantly lower client satisfaction and higher CD4 counts than clients receiving services at more centralized facilities (e.g., tertiary hospitals) (Tran & Nguyen, 2012). A retrospective cohort study conducted in Nigeria found that PLWHA receiving ART at satellite sites had significantly lower CD4 counts at 12 and 24 weeks and higher rates of viral suppression at 12 weeks when compared to individuals who received ART at primary sites (Okonkwo et al., 2014). However, the effects dissipated over time, with similar CD4 counts returning at 48 weeks and rates of viral load suppression evening out by 24 weeks (Okonkwo et al., 2014).

A study conducted in the Central province of Kenya evaluated decentralization as a model of care for HIV (Reidy et al., 2014). While more patients enrolled in HIV programs at primary health care facilities when services were decentralized from secondary health facilities, CD4 count and ART initiation remained similar across the two facility types. However, patients enrolled in HIV programs at primary health care facilities had a lower risk of loss to follow-up than those enrolled at secondary health facilities. In a 2012 study exploring the relationship between decentralization and ART delivery from a patient perspective, patients reported that the decentralization of ART delivery to lower-level health facilities can improve the quality of care and have a positive impact on HIV-infected patients' well-being (Boyer et al., 2012).

Two comparative analyses from Brazil suggest that, over the long term, decentralization may have a centralizing effect on some administrative and financial components of a national HIV/AIDS response (Frasca et al., 2018; Gómez, 2011). Additionally, Frasca, Faure, and Atlani-Dualt (2018) suggest that decentralization undermined Brazilian efforts to control their HIV epidemic by empowering local elites, marginalizing the human rights focus of their national response, and removing federal oversight.

Additional Considerations Regarding Decentralization and Health

According to Abimbola, Baatiema, and Bigdeli (2019), decentralization can alter the existing patterns of inequities in the distribution of resources, thus allowing more space for increased or leveraged local initiative, improved information sharing, and a greater number of channels and opportunity for local input and control. Additionally, a decentralized structure that establishes multiple centers of governance provides space for accountability and support (Abimbola et al., 2019; Bossert & Mitchell, 2011).

A qualitative analysis using the decision space approach explored the experiences of 27 key decision-makers in the Philippines (Liwanag & Wyss, 2018). The authors identified five conditions that enable the effectiveness of decentralization, including 1) having a multi-stakeholder approach and monitoring implementation, 2) the capacity to raise revenues at the local level and pooling of funds at the central level, 3) having a central level capable of augmenting resource needs at local levels and a good working relationship between local health staff and elected officials, 4) promoting innovation at local levels while maintaining fidelity to national objectives and, 5) ensuring that data collection from local levels is performed in a timely and accurate manner.

Ciccone, Vian, Maurer, and Brandley (2014) reviewed 30 peer-reviewed studies exploring the links between governance mechanisms and health outcomes in LMICs. Most identified studies found a positive association between governance mechanisms, including decentralization and health outcomes (Ciccone et al., 2014). However, the presence of six studies that identified no association between governance mechanisms and health (n=4) or had inconclusive results (n=2) led the authors to conclude that further research is needed to understand the relationship between decentralization and health outcomes in LMICs and strengthen LMIC governance of health programs (Ciccone et al., 2014).

Summary

The literature paints a complex picture of the relationship between decentralization and health-related outcomes. There is a growing body of empirical work establishing a relationship between different types of decentralization and health-related outcomes, such as health systems administration, service delivery, human resources for health, and population and individual outcomes. However, the direction of the relationship appears to be inconsistent across studies.

Several salient points can be gleaned from the literature as it relates to the proposed study. First, more research is needed to establish the direction of the relationship between decentralization and health. Second, studies that employ an exclusively quantitative design appear to be more likely to find a positive relationship between decentralization and health-related outcomes than mixed-methods studies or comparative analyses. This suggests that the relationship is more complex, nuanced, and contextually-specific than can be conveyed through quantitative findings alone. Third, studies that explore the relationship between fiscal decentralization and health outcomes at the population level seem more likely to identify a positive relationship, while those that consider the nature of the relationship between fiscal decentralization and individual-level health outcomes are more likely to yield mixed results. Fourth, income and wealth (within and across countries) appear to influence the relationship between decentralization and health outcomes, but the direction of the relationship is not clear. This reinforces the importance of exploring the relationship between fiscal decentralization and HIV outcomes by income groupings.

CHAPTER 3: METHODS

Proof of Concept

In 2020, the author undertook a proof-of-concept ecological study to explore the relationship between government decentralization and HIV incidence in 111 low- and middle-income countries (LMICs) (Sapiano, 2020), replicating the design of Franco et. al. (2005). The study used ordinary least squares linear regression to describe the link between the aggregated level of government decentralization and HIV incidence (per 1000 population for all ages) after controlling for GDP, the Gini index, and government expenditure (Sapiano, 2020). The proof-of-concept study found that, before adjusting for confounders, LMICs in the least decentralized tertile had the highest rate of HIV incidence (1.39) when compared to the mid-decentralization tertile (0.41) and the most-decentralized tertile (0.31) (see Table 3). When GDP, GINI, and government expenditure were added to the model, the positive relationship between decentralization and HIV incident held true. In the adjusted model, countries in the least decentralized tertile had significantly lower HIV incidence rates when compared to countries in the middle-decentralization tertile and the high-decentralization tertile (Table 4).

These findings suggested that LMIC with higher levels of government decentralization may be better at controlling their HIV epidemics. The current project builds on the proof-of-concept study by looking more closely at the relationship between fiscal decentralization, changes in HIV incidence over time, and the HIV treatment cascade outcomes in LMICs, with a focus on fiscal decentralization, HIV outcomes, and their relationship in PEPFAR countries. It should be noted that the findings from the proof-of-concept study support the hypothesis that less

decentralization leads to better HIV outcomes. The hypothesis of the current study represents the alternative to that of the proof-of-concept study.

Table 3: Proof of Concept Study-HIV Incidence Stratified by Variables Included in the Regression Model

Variable		Countries n	Mean HIV Incidence (per 1000 uninfected)
All Countries		111	0.74
Decentralization Index	Least decentralized	36	1.39
	Middle decentralization	36	0.41
	Most decentralized	38	0.31
World Bank gross domestic income	Low income	30	0.68
	Lower middle income	37	0.90
	Upper middle income	44	0.62
	High income (excluded)	0	
Gross Domestic Product	Low GDP	35	1.30
	Mid GDP	35	0.53
	High GDP	36	0.38
GINI	Low inequality	34	0.15
	Mid inequality	34	0.31
	High inequality	36	1.55
Government Expenditure	Low expenditure	36	0.48
	Mid Expenditure	35	0.46
	High expenditure	37	1.40

Table 4: Proof of Concept Study- Results from Regression of Decentralization on HIV Incidence After Accounting for GDP, Gini, and Government Expenditure.

Variable	Level	Estimate (SE)	P-value
		0.22 (-0.56,	
Intercept		0.99)	0.589
Decentralization	Mid vs least	-1 (-1.72, -0.29)	0.007

Variable	Level	Estimate (SE)	P-value
	Most vs least	-1.27 (-2.1, - 0.44)	0.003
GDP		0.06 (-0.67, 0.78)	0.880
	Mid vs low	0.05 (-0.77, 0.88)	0.899
GINI		0.43 (-0.29, 1.14)	0.245
	Mid vs low	1.44 (0.79, 2.08)	<0.001
Government expenditure		0.39 (-0.25, 1.03)	0.233
	Mid vs low	1.41 (0.73, 2.1)	<0.001

Purpose Statement

The purpose of the current study was to determine if there is a relationship between fiscal decentralization and the outcomes that comprise the HIV treatment cascade in low- and middle-income countries. In the case that a negative relationship is identified, the project seeks to determine if the negative effects of decentralization on the HIV treatment cascade outcomes are reduced when PEPFAR is present.

The project builds upon the current understanding of the relationship between fiscal decentralization and HIV outcomes in LMICs funded through PEPFAR; its findings will make a novel contribution to the literature base. No existing studies explore the relationship between

fiscal decentralization and HIV outcomes (including all outcomes that comprise the HIV treatment cascade) in LMICs or the role that PEPFAR plays in that relationship. The findings from this project could be used to strengthen the ability of PEPFAR and other global HIV donor programs to 1) support LMICs as they work towards ownership of their national HIV program and 2) achieve and sustain HIV epidemic control.

Research Questions

The research questions of this project follow below. Note that while questions two and three represent the primary goals of this research, in order to answer them, it is necessary to first establish that PEPFAR is effective at controlling HIV epidemics in LMICs. Therefore, research question one has been added to address the effectiveness of PEPFAR.

1. Are LMICs that have PEPFAR programs better at controlling their HIV epidemics than LMICs that do not have PEPFAR programs?
 - a. Did LMICs with PEPFAR programs experience greater reductions in HIV incidence (2010-2019) than LMICs without PEPFAR programs?
 - b. Did LMICs with PEPFAR programs experience greater reductions in the treatment cascade variables than LMICs without PEPFAR programs?
2. Do LMICs that have higher degrees of fiscal decentralization have better HIV treatment outcomes than less decentralized LMICs?
3. Does the presence of PEPFAR change the relationship between fiscal decentralization and HIV treatment outcomes in LMICs?
 - a. Is the relationship between fiscal decentralization and HIV treatment outcomes different in LMICs with PEPFAR-supported HIV programs when compared to LMICs without PEPFAR-supported HIV programs?

- b. Does PEPFAR change the relationship between fiscal decentralization and HIV outcomes in LMICs?

Hypotheses

This work proposes a negative relationship between fiscal decentralization and the HIV treatment cascade outcomes in LMICs (i.e., countries with higher levels of decentralization will have worse HIV outcomes when compared to countries with lower levels of decentralization). This negative relationship is reduced when PEPFAR is present (i.e., PEPFAR minimizes this negative effect). Figure 2 presents an example that highlights the anticipated direction of the results if the hypothesis were to hold true.

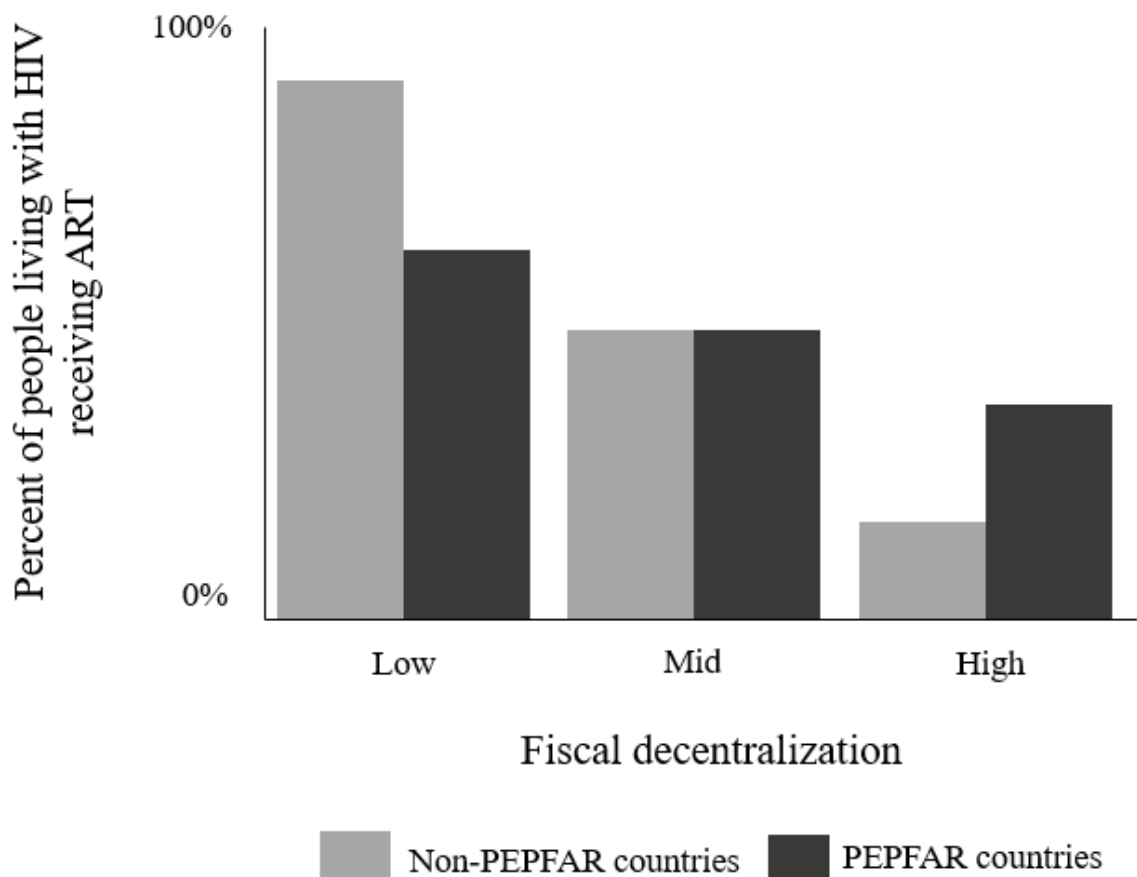


Figure 2: Anticipated Direction of Results for HIV Treatment Cascade Variable

Null Hypothesis

The null hypothesis denotes no relationship between fiscal decentralization and HIV outcomes in low-and middle-income countries.

Alternative Hypothesis

The alternative hypothesis proposes a positive relationship between fiscal decentralization and the HIV treatment cascade outcomes in LMICs (i.e., countries with higher levels of fiscal decentralization will have better HIV outcomes when compared to countries with lower levels of fiscal decentralization). This positive relationship is increased when PEPFAR is present.

Study Design

This study employed a cross-national ecological design. Statistical modeling was used to establish the efficacy of PEPFAR and to identify relationships between measures of fiscal decentralization and the three HIV treatment cascade outcomes, including understanding the role that PEPFAR played as both a predictor of HIV treatment outcomes and as an effect of the relationship between decentralization, HIV incidence, and HIV treatment outcomes.

Quantitative Analysis

The following section will detail the quantitative analysis conducted in pursuit of these answers. A complete list of the selected variables, definitions, and data sources can be found in Table 3.3.

Dependent Variables

ART provision and viral load suppression are key elements of PEPFAR and UNAIDS' strategies to achieve HIV epidemic control and end the HIV epidemic by 2030 (PEPFAR, 2022af). The global collective goal is for each country to reach 95-95-95, in which 95% of

people with HIV know their status, 95% of people who know their status are taking ART, and 95% of people on ART are virally suppressed (UNAIDS, 2020). It is projected that achieving 95-95-95 will reduce the number of new HIV infections below the total number of deaths from all causes among people with HIV, which is PEPFAR's definition of epidemic control (PEPFAR, 2022af).

The four primary dependent variables were 1) HIV incidence (new HIV infections) per 1000 population all ages, 2) the percentage of people living with HIV who know their status, 3) the percentage of people living with HIV receiving antiretroviral therapy (ART), and 4) the percentage of people living with HIV who have suppressed viral loads. The last three measures represent the UNAIDS HIV testing and treatment cascade (UNAIDS, 2020).

For the dependent variable HIV incidence (new HIV infections) per 1000 population all ages, the reduction incidence between a baseline year (chosen as 2010) and 2019 was calculated and used to answer research question number one: are LMICs with PEPFAR programs better at controlling their HIV epidemics than those without?

The other three dependent variables in this study represent the HIV cascade. Although UNAIDS has been reporting on global HIV incidence data since 1990, LMICs did not begin reporting HIV treatment cascade variables to UNAIDS in earnest until 2015, driven primarily by PEPFAR reporting requirements established in the early 2010s. As such, PEPFAR pre-dates baseline year data available in the dataset; therefore, the UNAIDS HIV treatment cascade data were not well suited to understanding PEPFAR's impact on changes over time for these three variables.

While 2010 data provided the percentage of people living with HIV receiving antiretroviral therapy (ART), the ART rollout in LMICs, which began in 2010, was

unstandardized and inconsistent until the dissemination of the first WHO Consolidated Guidelines on HIV Prevention, Testing, Treatment, Service Delivery and Monitoring Guidelines (otherwise known as the “test and treat guidelines”), released in 2016 (WHO, 2021). In addition, two of the HIV treatment cascade variables, 1) the percentage of people living with HIV who know their status, and 2) the percentage of people living with HIV who have suppressed viral loads, both started in 2015; this span of time is insufficient to measure PEPFAR performance due to the complexity of the interventions.

Independent Variables

The primary variable of interest for the statistical modeling exercise was fiscal decentralization as defined by the Ivanyna and Shah Decentralization Index (2014), which focuses on the relative importance of local government as the primary measure of decentralization. Their decentralization index, which covers 182 countries and represents one point in time, 2005, is the only one available that includes all PEPFAR-supported countries (Harguindéguy et al., 2021). Three of the four decentralization indices calculated by Ivanyna and Shah (2014) are of interest in the current analysis: political decentralization, administrative decentralization, and fiscal decentralization; the latter was used for the main analysis. Fiscal decentralization was selected as the independent variable of interest because the empirical literature has established a relationship between fiscal decentralization and health outcomes (Cavalieri & Ferrante, 2016; Dougherty et al., 2022; Hao et al., 2021; Jiménez-Rubio & García-Gómez, 2017). While not the primary variables of interest, models were created using the political and administrative decentralization indices calculated by Ivanyna and Shah (2014). The findings from these models will be used to explore the effects of administrative and political decentralization on the HIV treatment cascade outcomes, which will then be compared to the

effects of fiscal decentralization on the same. These results will be used to enhance the main findings and expand the discussion.

Fiscal Decentralization Index. The Ivanyna and Shah (2014) index uses the following concepts to assess local government fiscal autonomy: 1) the vertical fiscal gap, or the measure of fiscal dependence of the local government on higher level financing; 2) taxation autonomy, or the local government's empowerment and access to tools to finance their expenditures without recourse to higher-level governments; 3) unconditional grants; 4) expenditure autonomy, or the ability of local governments to allocate and spend unconditional grants; and, 5) borrowing freedom, or the ability of local governments to borrow money to satisfy their capital needs (Ivanyna & Shah, 2014).

Administrative Decentralization Index. The Ivanyna and Shah (2014) administrative decentralization index measures local government control over hiring, firing, and other human resource policies for local employees. The measures included in the index includes 1) the local government share of total public sector employment, and 2) local government discretion related to employment and setting the terms of that employment (Ivanyna and Shah (2014).

Political Decentralization Index. This index focuses primarily on the use of home rule for local self-governance. The index focuses on the following measures: 1) how legislative bodies are installed, whether they are elected or appointed, or a combination of the two; 2) whether executive heads at the local level are elected—directly or indirectly—or appointed; and 3) the existence of legislative provisions for obligatory local referenda for major spending, taxing, and regulatory decisions, recall of public officials, and requirement for direct citizen participation in local decision-making processes (Ivanyna & Shah, 2014).

Other Independent Variables. Status as a PEPFAR-funded country was included as a binary variable for question 1b. PEPFAR provided varying degrees of monetary and technical support to over 45 countries in 2019. The 25 countries selected for this analysis were those for which a PEPFAR Country Operating Plan (COP) for 2019 were publicly available on the PEPFAR website (State, n.d.). COPs, developed collaboratively among PEPFAR field teams, host-country governments, implementing partners, multilateral organizations, and civil society organizations, are used to guide the PEPFAR work in the country. In 2019, Haiti and the Dominican Republic submitted a joint COP; even so, they were included as independent countries in the analysis. For 23 of the 25 included countries, PEPFAR represents at least one third of the national HIV program budget.

Other countries that receive funding through a Regional Operating Plan (ROP) process have not been designated in the analysis as PEPFAR-supported countries. In ROP countries, PEPFAR generally plays a less pronounced role in the national HIV program and overall health system. ROP programs tend to have smaller individual country PEPFAR budgets, receive only technical assistance or funding (as opposed to both), lack a dedicated PEPFAR office in-country, and do not garner the same amount of bilateral attention. Table 6 provides a snapshot of the size of the PEPFAR programs in the 25 PEPFAR-supported countries included in the analysis (Andrews, 2021).

To test PEPFAR funding as a confounder, a three-level version of the binary PEPFAR variable was constructed and included in the model, based on the 2019-dollar total spent by PEPFAR per incident case, which categorized countries as either 1) non-PEPFAR, 2) below the median PEPFAR dollar spent per incident case or 3) above the median PEPFAR dollar spent per incident case. As the relationship between incidence reduction and fiscal decentralization

remained unchanged with this three-level variable, the decision was made to keep PEPFAR as a binary variable in all models. See Appendix A at the end of this document for the list of the PEPFAR-supported countries, by funding level and fiscal decentralization tertile.

Table 5: Summary of Variables in Statistical Analysis

Outcome	Name	Description	Notes
Dependent variables	Reduction in HIV incidence, 2010 minus 2019 [OLS]	Reduction in HIV incidence per 1000 population all ages between 2010-2019.	The source is UNAIDS (2019) https://aidsinfo.unaids.org/
	% of HIV positive persons with known status, 2015 to 2019 [Panel]	Percentage of people of all ages living with HIV who know their status.	
	% of people living with HIV receiving ART, 2010 to 2019 [Panel]	Percentage of people of all ages living with HIV receiving antiretroviral therapy (ART).	
	% of people living with HIV with VLS, 2019 [OLS]	Percentage of people of all ages living with HIV who have suppressed viral loads (i.e. viral load suppression; VLS).	
Independent variables	Fiscal decentralization	Index assigning a measure to assess local government fiscal autonomy.	Source is Ivanyna, M. Shah, A. (2014). How close is your government to its people?
	Administrative decentralization	Index assigning a measure to local government control regarding hiring, firing, and other human resource policies of local employees.	Worldwide indicators on localization and decentralization. Economics, 8(1). Single timepoint- 2005
	Political decentralization	Index assigning a measure to the degree to which the sub-national and local governments are governed by their own citizens.	
	PEPFAR country status	Binary variable- PEPFAR country Yes/No	PEPFAR Country Operating Plans 2019 (State, n.d.) https://www.state.gov/pepfar-

Confounding variables			
	Income group classifications	Four categories that reflect the income groups of the world's economies.	country-and-regional-operational-plans/ The World Bank (2019) https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fdatacatalogfiles.worldbank.org%2Fddh-published%2F0037712%2FD0090755%2FCLASS.xlsx&wdOrigin=BROWSELINK
	Gini coefficient	Gini is a statistical measure representing the level of income inequality in a country	The World Bank (2019) https://data.worldbank.org/indicator/SI.POV.GINI
	Population size	The total size of a country's population	The World Bank's Total Population Index (2019) https://data.worldbank.org/indicator/SP.POP.TOTL?view=chart
	Government effectiveness	Measure that captures perceptions of the quality of public services, quality of the civil service and degree of its independence from political pressures, quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	The World Bank (2019) http://info.worldbank.org/governance/wgi/Home/Documents
	Global freedom as a proxy measure for democracy	A measure of degree of global freedom status	Freedom House (most recent) https://freedomhouse.org/explore-the-map?type=fiw&year=2023

Table 6: PEPFAR Country Program Snapshot

Country	2019 Population, millions	National HIV program budget* (USD, millions)	PEPFAR approved funding** (USD, millions)	% PEPFAR	HIV incidence per 1000- all ages	% HIV positive persons on treatment
Angola	32	-	10	-	0.65 [0.47 - 0.87]	30 [25 - 35]
Botswana	25	60	48	79%	4.13 [3.64 - 4.60]	87 [82 - 92]
Burundi		33	18	55%	0.14 [0.09 - 0.22]	89 [77 - >98]
Cameroon	26	99	97	98%	0.74 [0.58 - 0.89]	62 [58 - 67]
Cote d'Ivoire	26	120	105	87%	0.28 [0.17 - 0.43]	68 [61 - 77]
Dominican Republic	11	-	26	-	0.41 [0.24 - 0.57]	45 [38 - 54]
Democratic Republic of Congo	90	107	78	73%	0.25 [0.16 - 0.36]	60 [50 - 71]
Eswatini	1	98	80	81%	9.40 [7.83 - 10.89]	89 [83 - 94]
Ethiopia	114	190	117	62%	0.14 [0.12 - 0.15]	76 [72 - 79]
Haiti	11	125	102	82%	0.50 [0.38 - 0.69]	74 [67 - 84]
Kenya	50	750	375	50%	0.78 [0.51 - 1.16]	77 [70 - 89]
Lesotho	2	125	85	68%	5.72 [5.10 - 6.12]	75 [71 - 81]
Malawi	19	240	159	66%	1.34 [1.09 - 1.67]	84 [79 - 92]
Mozambique	30	545	330	61%	0.70 [0.40 - 1.20]***	84 [68-100]
Namibia	2	150	81	54%	3.41 [2.85 - 4.03]	83 [78 - 91]
Nigeria	203	525	392	75%	0.53 [0.43 - 0.65]	60 [57 - 67]
Rwanda	13	152	75	49%	0.37 [0.35 - 0.43]	88 [83 - 93]
South Africa	58	2,543	753	30%	4.80 [4.27 - 5.35]	73 [68 - 79]
South Sudan	10	32	20	63%	1.25 [1.17 - 1.46]	22 [21 - 24]

Country	2019 Population, millions	National HIV program budget* (USD, millions)	PEPFAR approved funding** (USD, millions)	% PEPFAR	HIV incidence per 1000- all ages	% HIV positive persons on treatment
Tanzania	60	530	410	77%	1.38 [1.30 - 1.66]	75 [73 - 82]
Uganda	43	455	409	90%	1.41 [1.21 - 1.82]	80 [76 - 88]
Ukraine	44	92	30	33%	0.18 [0.14 - 0.24]	57 [50 - 64]
Vietnam	96	98	38	39%	0.07 [0.06 - 0.08]	66 [60 - 72]
Zambia	18	480	421	88%	3.05 [2.62 - 3.48]	83 [79 - 88]
Zimbabwe	15	300	163	54%	1.88 [1.40 - 2.59]	87 [80 - 95]

Notes: * Estimates taken from SID 2019 reports; ** Approved funding taken from SID 2019 reports; ***Mozambique 2019 incidence reflects only adults 15-49.

Control or Confounding Variables

Confounding variables are country characteristics that may have an independent effect on the relationship between decentralization and HIV testing and treatment outcomes. Multiple confounding variables were included in the statistical modeling (see Table 5). A country's total wealth, likely to be an important factor, was measured using two competing variables. The first of these, World Bank income group classification (i.e., high income, upper middle income, lower middle income, low income, and unclassified), used the following 2019 income groupings: low income=\$1,085 or less gross national capital (GNI) per capita; lower middle income=\$1,086-\$4,255 GNI per capita; upper middle income=\$4,256-\$13,205 GNI per capita; and high income=\$13,206 or more per capita (The World Bank, 2022d).

The Gini coefficient is a statistical measure representing the annual level of income inequality in a country. Income inequality was included as a variable “to ensure that any possible effects of decentralization do not capture the impact of redistributive pressures arising from economic inequality” (Justesen, 2012). Population size was considered to “address the concern that, all else equal, smaller countries may react differently to HIV epidemics than larger ones” (Justesen, 2012). Government effectiveness, a composite measure, captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. There is existing literature linking health outcomes and HIV-specific outcomes to democracy (Bollyky, 2019; Barnish, 2018), which suggests that democracy may be a confounder of the relationship between decentralization and HIV outcomes. To address this, global freedom was included in the model as a proxy measure for democracy. Data on income grouping, Gini, population size, and government effectiveness

was obtained from the World Bank (The World Bank, 2022a, 2022b, 2022c, 2022e). Data on global freedom was obtained from Freedom House (House, 2023).

The literature suggests many potential confounding or control variables. However, in an ecological design such as this, it is necessary to focus on the most direct and important variables to maintain a parsimonious model. As Babyak (2004) points out, one must also avoid overfitting regression models with smaller numbers of cases, such as the ones used in this analysis, as it can lead to uncertainty of findings (Babyak, 2004). For this reason, other variables were not included.

Quantitative Analysis Sample

Countries for which UNAIDS had any data in 2019 were selected for potential inclusion in the dataset (N=172). A series of data exclusion criteria were then applied to the dataset (see Figure 3.2 for a flow diagram). The exclusion criteria were countries classified as high-income by The World Bank in 2019, countries with populations of less than one million according to The World Bank in 2019, countries missing decentralization data, and countries missing 2019 data for one or more of the confounders. After the application of exclusion criteria, the final dataset was comprised of 96 countries. Eight countries included in the final dataset (n=96) had not reported data to UNAIDS for the four response variables.

Using the final dataset, four analytic datasets were created, one for each dependent variable. See Appendix B at the end of this document for the list of the countries included in the final dataset for each of the four response variables of interest. The number of countries included in the analytic dataset for each independent variable of interest varied based on the number of countries for which UNAIDS had data available for the time-period of interest. The number of years of data included in the different analysis varied. To engage in as robust analyses

as possible, this project sought to use timeseries data. However, HIV reporting as well as testing and treatment technologies have evolved inconsistently since 2010. As a result, the country sample size for each of the individual model datasets varied due to the number of years for which data was reliably available through UNAIDS. The number of years included as a time series for each analysis as well as the sample size for each of the outcomes of interest are highlighted in Figure 3 below.

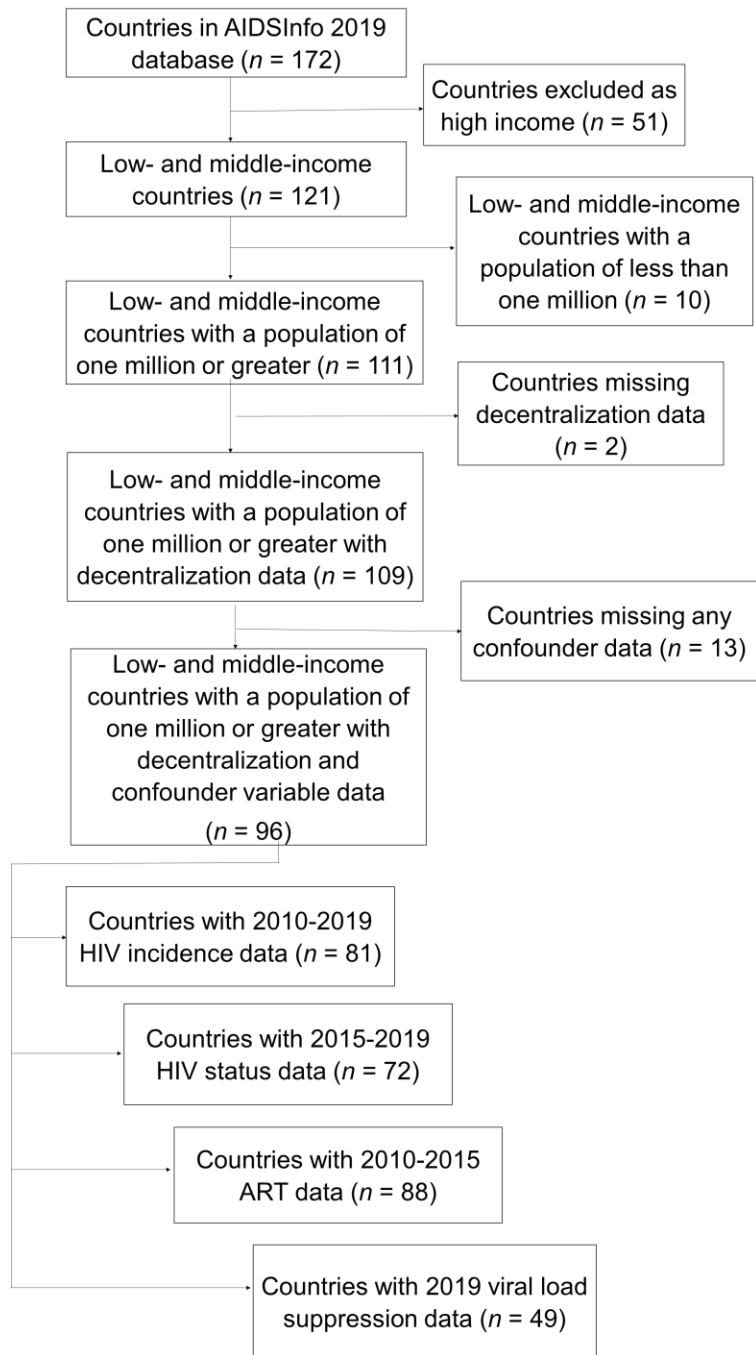


Figure 3: Flowchart of Data Exclusions and Analysis Sample Sizes

Data Management

Data was extracted from the sources identified in Table 5 and integrated into a single dataset by matching independent variables to the dependent variables by country and year. Data was cleaned and analytic datasets were created for each model using the criteria highlighted in Figure 3. Upon review, outliers made it difficult to say with certainty that there was a continuous linear relationship between the confounding, dependent, and independent variables; therefore, the decision was made to transform the continuous variables to categorical variables. The use of categorical variables increases the robustness of the results by ensuring the parsimony of the models and decreasing opportunities for overfitting. See Appendix C for the list of PEPFAR country decentralization tertiles.

Variables were split into either three, four, or five arbitrary groupings, based on tertiles, quartiles, or quintiles. Binary grouping, used for PEPFAR vs. Non-PEPFAR countries, was not considered for any of the other variables (i.e., above or below the median). Tertiles were calculated by estimating the 33rd and 66th percentile and then grouping the data into low (\leq 33rd percentile), mid ($>$ 33rd percentile and \leq to the 66th percentile), and high ($>$ 66th percentile). Quartiles indicated 25th, 50th, and 75th percentiles, and quintiles were based on the 20th, 40th, 60th, and 80th percentiles, using a similar methodology.

To select the most appropriate grouping, each variable was included as tertiles, quartiles, and quintiles in each of the univariate ordinary least squares regression models for each independent variable. The middle group was selected as the reference group, or intercept which defines testable contrasts between low/middle/high groups. The final grouping selected (i.e., tertile, quartile, or quintile) for inclusion in the multivariate model was based on which was most appropriate for each model. Groupings were harmonized across all dependent outcome variables

(i.e., tertiles), but were different for each of the confounding variable (i.e., tertiles and quartiles). In summary, the same groupings were used for types of decentralization across all models. Different groupings were used for the confounding variables, the grouping for which remained consistent across models. All analyses were conducted using R software (Team, 2018; Wickham et al., 2019).

Methods and Analysis

First, descriptive statistics were used to generate histograms depicting the distribution of countries by the two independent variables. Next an ordinary least squares multiple linear regression analysis was conducted to relate measures of decentralization to changes in the HIV outcomes. Time series data was used for the two outcomes for which sufficient data existed: percentage of HIV positive persons with known HIV status, 2015 to 2019 and percentage of people living with HIV receiving ART. To establish the optimal set of control variables, the model was built in a stepwise approach. For the regression analysis, univariate models of the HIV treatment cascade measures and each of the control variables were fitted, before building a multiple linear regression containing the control variables. The collinearity of control variables was explored before model fitting, using scatterplots and correlation statistics. Once the multiple linear regression model with control variables was built, PEPFAR was added as an interaction to the model to determine how this intervention affected the impact of decentralization on the outcomes of interest, essentially exploring the effect of PEPFAR on the relationship between fiscal decentralization and HIV epidemic control. Next, additional measures of political and administrative decentralization were fitted to explore the effects of other types of decentralization on the HIV outcomes of interest, to compare these effects to those between fiscal decentralization and HIV outcomes.

To address question one (“are LMICs with PEPFAR programs better at controlling their HIV epidemics than LMICs without?”), a calculated variable was created and included in the models to establish the effectiveness of PEPFAR as an HIV program, by 1) measuring the changes in HIV incidence between 2010-2019 and 2) comparing those to changes in HIV incidence and HIV treatment cascade outcomes in non-PEPFAR countries from the same time points. This data provides insight as to the effectiveness of PEPFAR in addressing the HIV epidemic in LMICs.

To address question three (“does PEPFAR affect the relationship between decentralization and HIV treatment cascade measures?”), an interaction effect was fitted in the model and tested for its statistical significance. When interpreting the results, it is important to note that the sample size may be too small to accurately identify a moderation effect (Edwards, 2020).

Strengths and Limitations

Strengths

This study employed a non-experimental, ecological design, which replicates and builds on a series of previously published studies exploring the relationship between political institutions related to democracy (e.g., decentralization) and health outcomes (Franco et al., 2005; Goel et al., 2017; Justesen, 2012; Khaleghian, 2004; Mackenbach & McKee, 2015), including an unpublished work by the author (Sapiano, 2020). This research, the first to quantitatively examine the relationship between government decentralization and the HIV treatment cascade in PEPFAR-supported countries, should be considered foundational for future inquiry into the associations between political institutions and HIV donor programs operating in recipient countries.

Limitations

This project employed an ecological design to assess the overall reduction of HIV incidence (2019 minus 2010) and differences in HIV treatment cascade outcomes across LMICs, to look for cross-country correlations within the context of degrees of fiscal decentralization. Certain limitations associated with ecological studies may limit causal inference, and must be considered when interpreting these findings, such as ecological and cross-level bias, small sample size, problems of confounder control, within-group misclassification, lack of adequate data, temporal ambiguity, collinearity, and migration across groups (Singleton & Straits, 2018). Other study weaknesses and limitations may affect interpretation of these results. First, the quantitative data used may not reflect the dynamic socio-cultural, historical, and economic contexts of the included LMICs. Secondly, systematic differences in data collection and reporting, service provision, tracking, and the accuracy and availability of data on confounding factors varies across countries. Next, there is the potential for systematic differences between countries in the measurement of decentralization (i.e., availability of data, consistency of data, timeliness of data). In addition, the LMICs included in the study may have experienced changes in decentralization between the timepoint of the decentralization indices (2005) and that of the independent variables (2019). Finally, the current study includes measures that may represent a proxy on the average of a population. The latter subjects the findings to the ecological fallacy, the erroneous use of information pertaining to an aggregate (Singleton & Straits, 2018), which follows from inappropriately-inferred individual-level conclusions based on results from aggregate- or population-level data. It is therefore important not to overgeneralize the findings of the current ecological analysis.

Further, findings from the literature state that quantitative findings from ecological studies exploring the relationship between decentralization and health outcomes tend to skew positive. There is also a risk of overinterpreting the results of this analysis (Cobos Muñoz et al., 2017). Overinterpretation, or distortion, of study findings refers to reporting practices that mislead readers by being more optimistic about the conclusions than the results justify (McGrath et al., 2017). This concept should also be considered when reviewing the findings of this project.

As an additional limitation of this study design, country-level analysis may not capture the nuances of infectious disease outbreaks and subsequent epidemics. For instance, there may be important intra-country factors and dynamics related to infectious diseases (e.g., transmission dynamics) that cannot be controlled for in a country-level analysis. This may explain the dearth of literature exploring the relationship between political determinants of health and outcomes, beyond the standard population-level markers of life expectancy, infant mortality, and maternal mortality. Additionally, the decentralization index, though published in 2014, was based on data from the mid-2000s (Ivanyna & Shah, 2014).

CHAPTER 4: RESULTS

Descriptive Statistics

Dependent and Independent Variables

Figures 4, 5, and 6 below highlight the mean of the dependent variables by 1) decentralization tertile (independent variables) and 2) PEPFAR status across LMICs after the application of data exclusions ($n = 96$). See Appendices C and D at the end of this document for the distribution and the relationship of values of the dependent and independent variables across all countries, by PEPFAR country status, after data exclusions have been applied. The dependent variables include reduction in HIV incidence (2019 minus 2010), percent of people living with HIV who know their status, percent of people living with HIV receiving ART, and percent of people living with HIV with suppressed viral loads. The independent variables include fiscal, political, and administrative decentralization.

Figure 4 shows bar charts of the mean of dependent variables by fiscal decentralization tertile and PEPFAR country status for (A) reduction in HIV from 2010-2019, (B) percentage of people with HIV that know their status, (C) percentage of people with HIV who are on ART, and (D) percentage of people with HIV who have suppressed viral loads. PEPFAR countries are represented by the black bars and non-PEPFAR countries in grey, demonstrating that PEPFAR countries have experienced a greater reduction in HIV incidence and perform better across the treatment cascade than do non-PEPFAR countries. Across dependent variables, PEPFAR countries in tertile three, or the most fiscally decentralized countries, appear to have the best HIV-related outcomes.

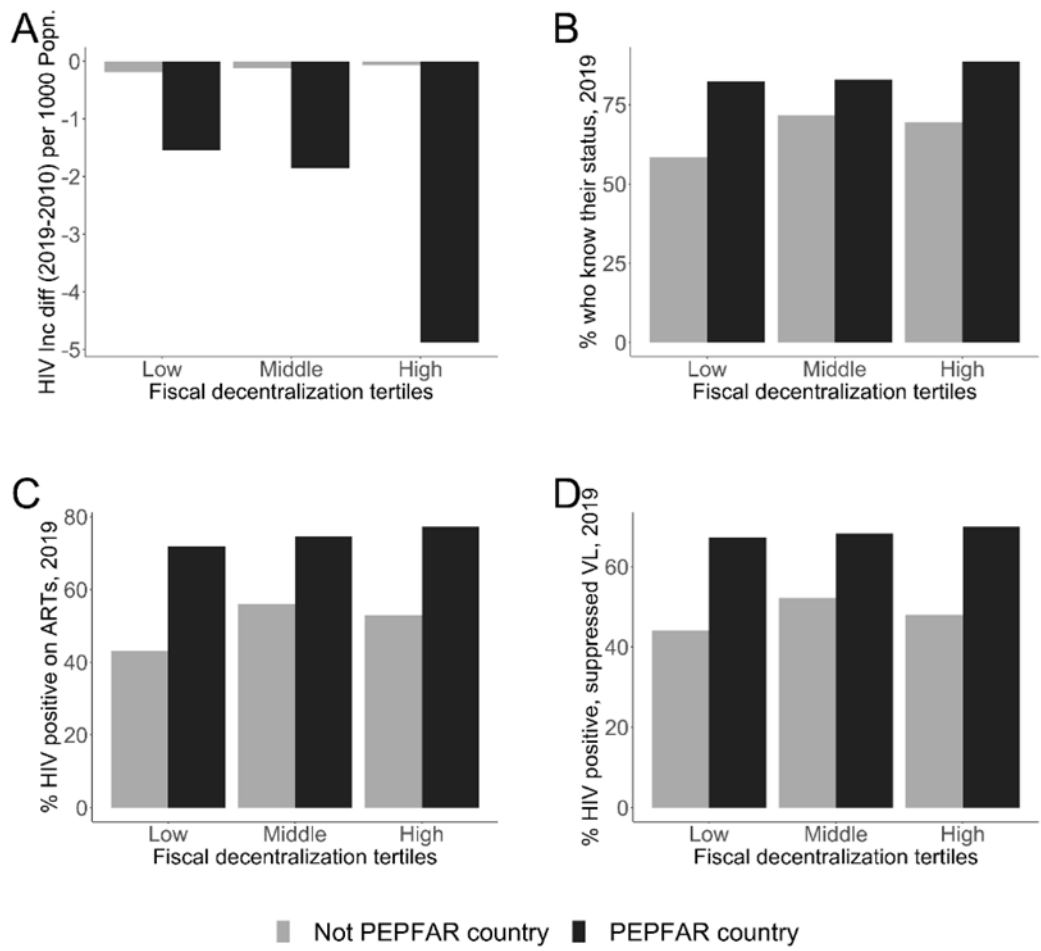


Figure 4: Mean of Dependent Variables by Fiscal Decentralization Tertile and PEPFAR Country Status

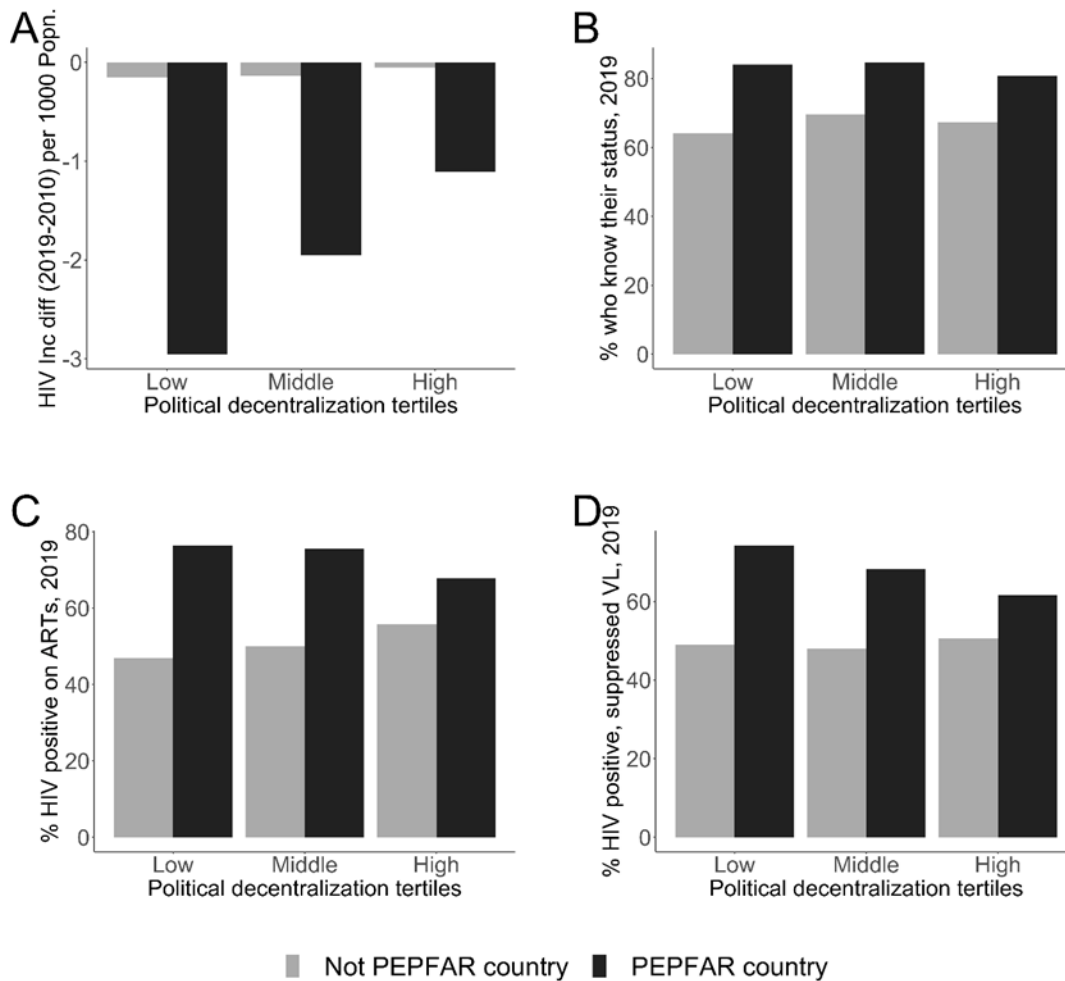


Figure 5: Mean of Dependent Variables by Political Decentralization Tertile and PEPFAR Country Status

Figure 5 presents bar charts of the mean of dependent variables by political decentralization tertile and PEPFAR country status for the four dependent variables (PEPFAR countries in black; non-PEPFAR countries in grey). As in Figure 4, Figure 5 demonstrates that PEPFAR countries experienced a greater reduction in HIV incidence and perform better across the treatment cascade than do non-PEPFAR countries. However, unlike countries in Figure 4, PEPFAR countries in tertiles one and two, or less politically-decentralized PEPFAR countries,

appear to have better HIV-related outcomes than more politically decentralized PEPFAR countries, or those in tertile three.

Figure 6 displays bar charts of the mean of dependent variables by administrative decentralization tertile and PEPFAR country status. As with Figures 4 and 5, PEPFAR countries appear to have better HIV outcomes compared to non-PEPFAR countries. Like Figure 5, PEPFAR countries in the lower administrative decentralization tertiles appear to have slightly better HIV-related outcomes than countries in tertile 3, or the most decentralized tertile.

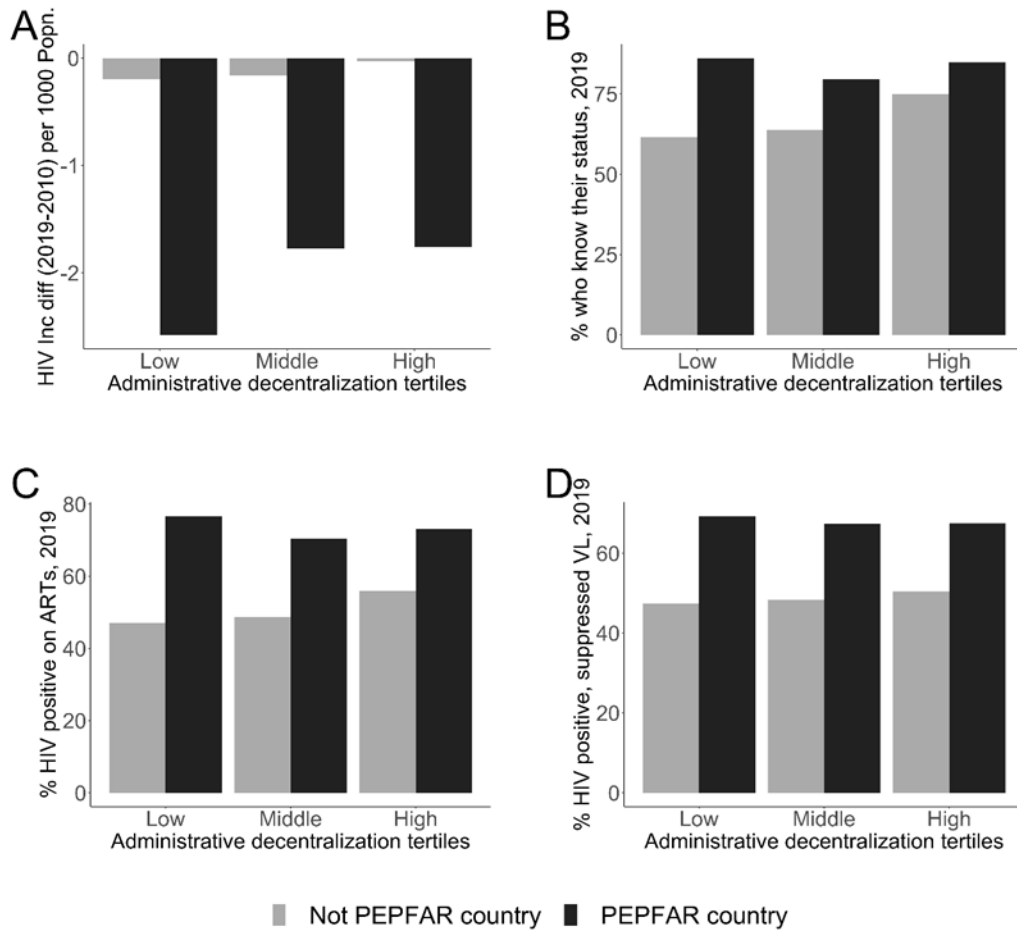


Figure 6: Mean of Dependent Variables by Administrative Decentralization Tertile and PEPFAR Country Status

The scatter plots in Figure 7 show the distribution of LMICs by degree of fiscal decentralization for (A) reduction in HIV incidence between 2010 and 2019, (B) percentage of people with HIV that know their status, (C) percentage of people with HIV who are on ART, and (D) percentage of people with HIV who have suppressed viral loads. Figure 7A highlights the relationship between fiscal decentralization and reduction in HIV incidence between 2010 and 2019, with non-PEPFAR countries more closely clustered around the trendline than PEPFAR countries for reduction in HIV incidence, possibly reflecting the fact that non-PEPFAR countries have less overall HIV. The PEPFAR countries with the highest overall HIV burdens (South Africa, Eswatini, and Lesotho) are the largest PEPFAR-country outliers when looking at panel A. Brazil, a notable non-PEPFAR county outlier, features both the highest degree of fiscal decentralization and a very minimal reduction in HIV incidence over the period. Brazil's positioning on this scatter plot appears to support the hypothesis of this project, which contends that countries with more fiscal decentralization have worse HIV outcomes than countries with less fiscal decentralization. This supports Frasca and colleagues (2018), who suggested that decentralization negatively influenced Brazil's ability to control their HIV epidemic.

Figures 7B, 7C, and 7D highlight the distribution of LMICs by fiscal decentralization for the three HIV treatment cascade variables. The relationship for all LMICs between fiscal decentralization and percentage of people who know their HIV status is slightly positive (Figure 7B), while fiscal decentralization and the percentage of people who are on ART (Figure 7C) appear to have no relationship. However, there does appear to be a slightly negative relationship between the percentage of people with suppressed viral loads and fiscal decentralization.

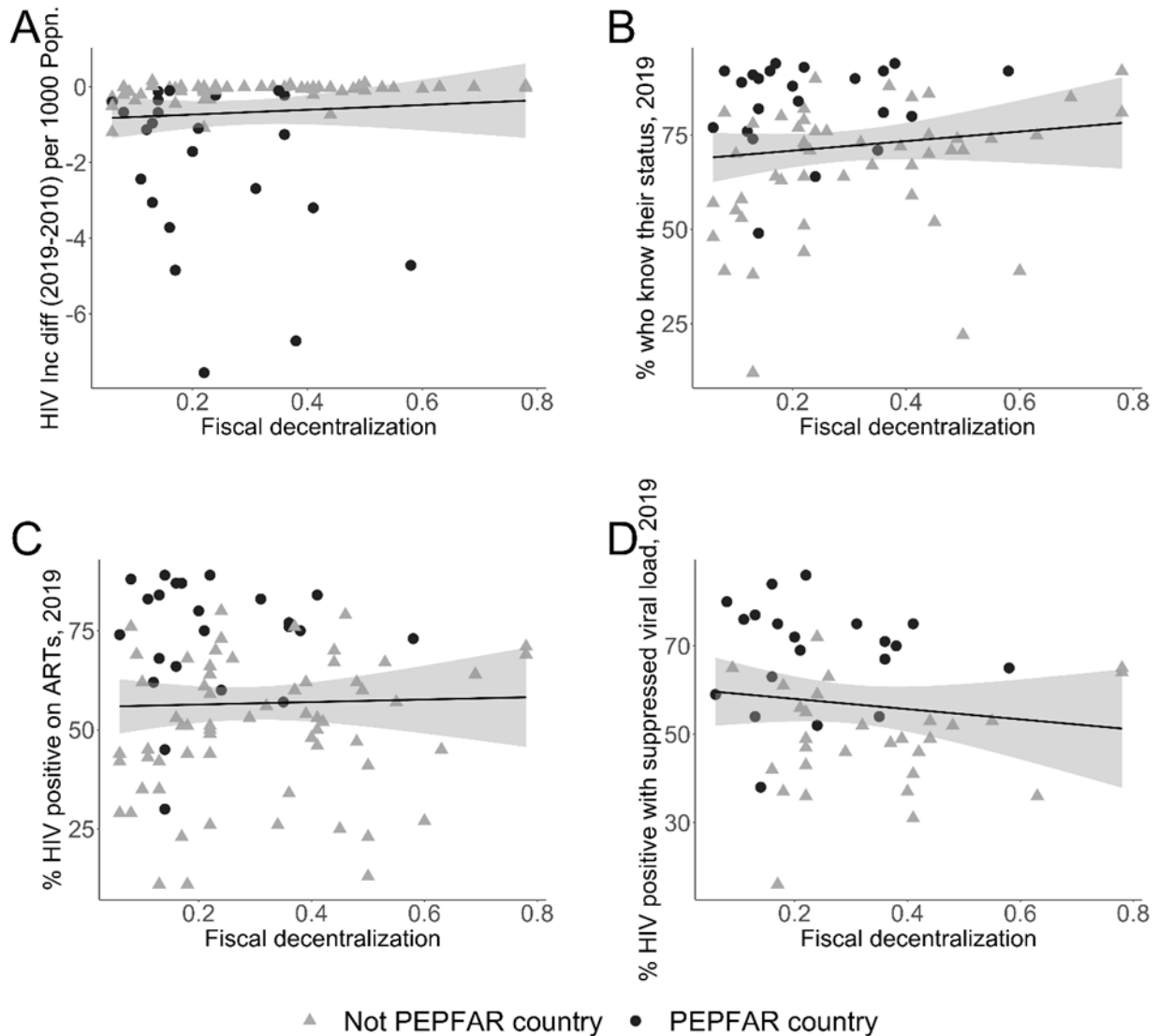


Figure 7: Distribution of LMIC by Degree of Fiscal Decentralization Across Independent Variables

Figure 8 suggests that PEPFAR countries are distributed similarly to non-PEPFAR countries across population and government effectiveness (see Figures 8A and 8C), toward the higher end of the Gini index (Figure 8B). The distribution of PEPFAR countries across the freedom index follows the same pattern as the distribution of non-PEPFAR countries, with more countries falling into the ‘not free’ tertile than the ‘free tertile’ (Figure 8E). The majority of PEPFAR and non-PEPFAR countries fall into the ‘partially free’ tertile. When it comes to

income distribution, the pattern for PEPFAR countries is opposite of that for non-PEPFAR countries, with more PEPFAR countries falling into the low-income group than the high-income group. For both PEPFAR and non-PEPFAR countries, the largest number of countries fall within the middle-income group.

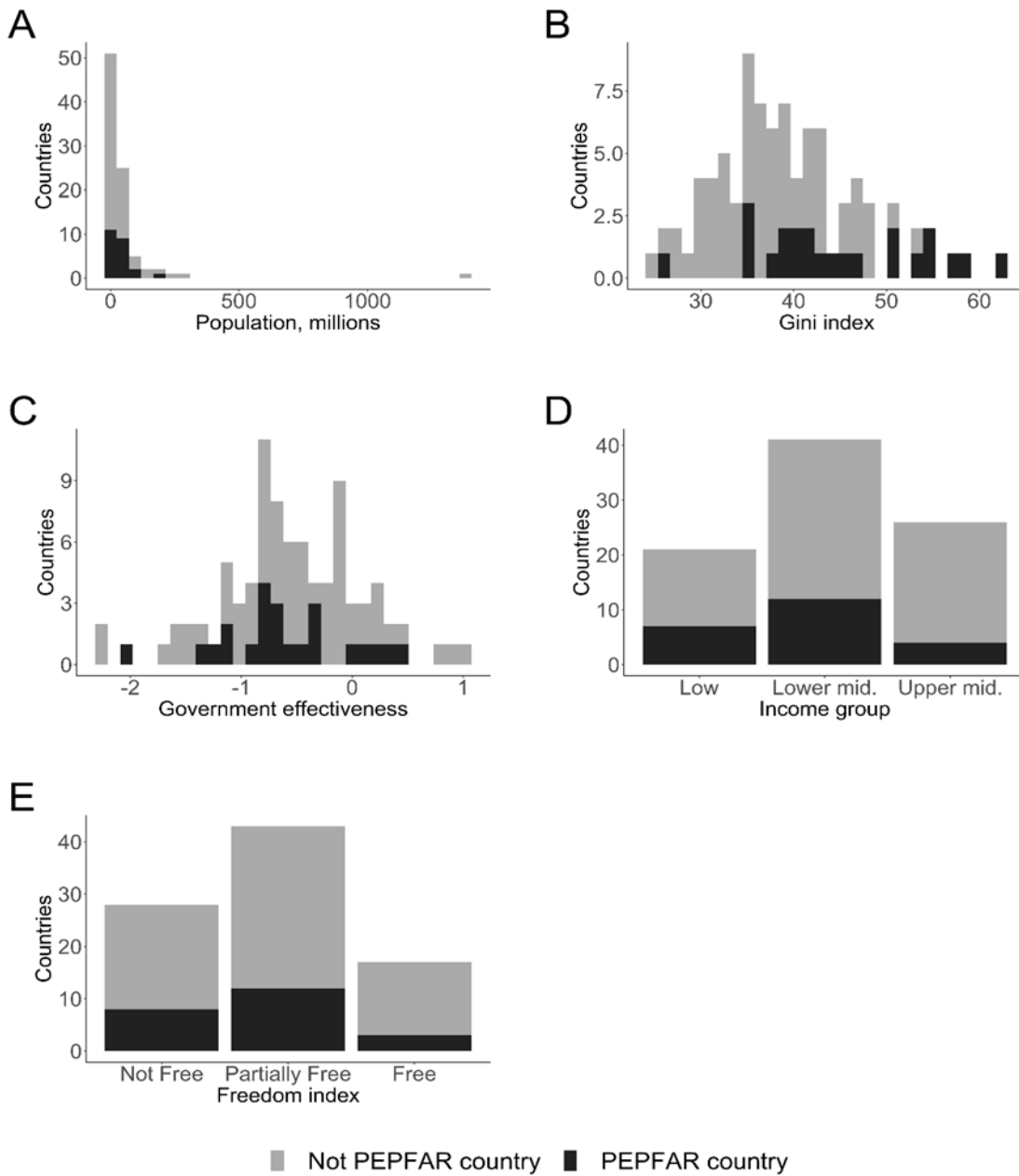


Figure 8: Country Distribution Across Confounders

Table 7: Descriptive Statistics for Dependent and Main Explanatory Variables

		HIV Treatment Cascade							
		Reduction in HIV incidence, 2019 minus 2010		Percent of people living with HIV who know their status - all ages (2015-2019)		Percent of people living with HIV who are on ART- all ages (2010-2019)		Percent of people living with HIV who have suppressed viral loads - all ages (2019 only)	
		Countries (n)	Mean (Median)	Countries (n)	Mean (Median)	Countries (n)	Mean (Median)	Countries (n)	Mean (Median)
Total		81 (81)	-0.68 (-0.10)	72 (341)	66.5 (69.0)	88 (880)	37.7 (36.0)	49 (49)	56.8 (55.0)
Income Group	Low income	19 (19)	-0.81 (-0.35)	19 (91)	63.1 (64.0)	21 (210)	37.5 (34.5)	7 (7)	70.7 (75.0)
	Lower middle income	37 (37)	-0.72 (-0.10)	33 (158)	63.7 (66.0)	41 (410)	34.0 (32.0)	25 (25)	56.2 (55.0)
	Upper middle income	25 (25)	-0.52 (-0.03)	20 (92)	74.7 (77.5)	26 (260)	43.7 (44.0)	17 (17)	52.0 (52.0)
Gini	Quartile 1 (<= 34)	17 (17)	-0.05 (-0.01)	20 (86)	57.8 (61.0)	25 (220)	27.9 (25.5)	12 (12)	49.3 (48.5)
	Quartile 2 (>34 to <= 39)	25 (25)	-0.38 (-0.12)	25 (89)	64.5 (70.0)	36 (230)	36.7 (36.0)	11 (11)	54.7 (54.0)
	Quartile 3 (> 39 to <=45)	20 (20)	-0.65 (-0.09)	24 (87)	71.1 (71.0)	33 (210)	42.1 (41.0)	12 (12)	57.4 (61.0)
	Quartile 4 (> 45 to <=63)	19 (19)	-1.65 (-0.21)	21 (79)	73.1 (76.0)	29 (220)	44.4 (43.0)	14 (14)	64.4 (65.0)
Government effectiveness	Quartile 1 (<= -2.5 to <= -0.95)	15 (15)	-0.59 (-0.22)	19 (77)	55.6 (54.0)	28 (221)	29.6 (27.0)	6 (6)	58.2 (57.0)
	Quartile 2 (> -0.95 to <= -0.58)	23 (23)	-1.31 (-0.28)	31 (97)	65.6 (70.0)	43 (219)	37.6 (35.0)	15 (15)	61.2 (67.0)
	Quartile 3 (> -0.58 to <= -0.16)	18 (18)	-0.19 (-0.05)	27 (83)	70.3 (71.0)	44 (221)	40.0 (38.0)	12 (12)	51.6 (51.0)
	Quartile 4 (> -0.16 to <= 1.1)	25 (25)	-0.50 (-0.02)	21 (84)	73.8 (75.5)	30 (219)	43.7 (44.0)	16 (16)	56.2 (56.0)

		HIV Treatment Cascade							
		Reduction in HIV incidence, 2019 minus 2010		Percent of people living with HIV who know their status- All ages (2015-2019)		Percent of people living with HIV who are on ART- All ages (2010-2019)		Percent of people living with HIV who have suppressed viral loads- all ages (2019 only)	
		Countries (n)	Mean (Median)	Countries (n)	Mean (Median)	Countries (n)	Mean (Median)	Countries (n)	Mean (Median)
Freedom Index	Not Free	25 (25)	-0.58 (-0.10)	21 (94)	65.6 (72.5)	32 (267)	35.1 (30.0)	11 (11)	60.3 (63.0)
	Partially Free	39 (39)	-0.72 (-0.10)	40 (176)	65.4 (67.0)	51 (427)	37.2 (36.0)	28 (28)	56.2 (54.5)
	Free	17 (17)	-0.71 (-0.05)	17 (71)	70.3 (70.0)	22 (186)	42.7 (43.5)	10 (10)	54.9 (55.5)
Population (millions)	Tertile 1 (<= 0.92 to <= 9.5)	27 (27)	-0.93 (-0.05)	24 (113)	67.5 (68.0)	32 (291)	37.0 (35.0)	15 (15)	53.1 (49.0)
	Tertile 2 (> 9.5 to <= 29)	25 (25)	-0.63 (-0.21)	29 (117)	68.1 (69.0)	36 (290)	38.7 (36.0)	17 (17)	56.1 (54.0)
	Tertile 3 (> 29 to <= 1400)	29 (29)	-0.48 (-0.05)	24 (111)	63.7 (70.0)	33 (299)	37.5 (36.0)	17 (17)	60.9 (65.0)
PEPFAR	Non-PEPFAR Country	58 (58)	-0.12 (-0.03)	50 (231)	60.9 (63.0)	65 (650)	33.2 (32.0)	29 (29)	49.1 (49.0)
	PEPFAR Country	23 (23)	-2.09 (-1.13)	22 (110)	78.2 (82.0)	23 (230)	50.4 (50.0)	20 (20)	68.1 (70.5)
Fiscal Decentralization Index	Tertile 1 (<= 0.06 to <= 0.18)	30 (30)	-0.73 (-0.24)	26 (126)	63.8 (64.0)	33 (330)	34.9 (31.0)	14 (14)	59.1 (62.0)
	Tertile 2 (> 0.18 to <= 0.37)	26 (26)	-0.65 (-0.09)	25 (118)	69.4 (71.0)	27 (270)	40.2 (38.5)	20 (20)	58.6 (55.5)
	Tertile 3 (> 0.37 to <= 0.78)	25 (25)	-0.64 (-0.03)	21 (97)	66.4 (70.0)	28 (280)	38.7 (40.0)	15 (15)	52.4 (52.0)
Political Decentralization Index	Tertile 1 (<= 0 to <= 0.33)	28 (28)	-1.05 (-0.17)	29 (145)	63.7 (65.0)	32 (320)	36.0 (33.0)	15 (15)	60.8 (65.0)
	Tertile 2 (> 0.33 to <= 0.5)	30 (30)	-0.56 (-0.10)	26 (120)	68.1 (70.0)	30 (300)	37.0 (35.0)	18 (18)	54.8 (55.0)
	Tertile 3 (> 0.53 to <= 0.83)	23 (23)	-0.37 (-0.03)	17 (76)	69.2 (71.0)	26 (260)	40.7 (42.0)	16 (16)	55.4 (53.0)
Administrative Decentralization Index	Tertile 1 (<= 0 to <= 0.06)	27 (27)	-0.99 (-0.28)	24 (119)	64.5 (67.0)	30 (300)	37.5 (36.0)	14 (14)	58.4 (57.5)
	Tertile 2 (> 0.06 to <= 0.35)	26 (26)	-0.66 (-0.17)	26 (123)	63.3 (64.0)	30 (300)	36.1 (34.0)	16 (16)	56.7 (53.0)
	Tertile 3 (>0.35 to <= 0.9)	28 (28)	-0.40 (-0.03)	22 (99)	72.8 (75.0)	28 (280)	39.7 (39.5)	19 (19)	55.8 (54.0)

Table 7 shows the number of countries, number of observations (n), and mean and median for each of the dependent variables under consideration: reduction in HIV incidence (2019 minus 2010), the percentage of people with HIV that know their status, the percentage of people with HIV that are on ART, and the percentage of people with HIV that have suppressed viral loads. The mean reduction in HIV incidence (2019 minus 2010) was -0.68 (based on 81 countries) with a median decrease of -0.10. The mean percentage of people with HIV that know their status was 66.5% (median was 69%), based on 341 observations across 72 countries. The mean percentage of people living with HIV on ART, 37.7% (median was 36%), was based on 880 observations across 88 countries. The mean percentage of people living with HIV with suppressed viral loads was 56.8% (median was 55%), based on 49 observations among 49 countries.

The upper middle-income group had a lower mean reduction in HIV incidence (2019 minus 2010) (-0.52% vs. -0.72% and -0.81% for low middle- and low-income groups) but had a slightly higher percentage of people with HIV that know their status (74.7% vs. 63.7% and 63.1%), and percentage of people on ART (43.7% vs. 34.0% and 37.5%). Conversely, the percentage of people with HIV that have suppressed viral loads was highest in the low-income group (70.7%) when compared to the lower middle-income group (56.2%) and the upper middle-income group (52.0%).

Countries with the highest income inequality demonstrated the greatest reduction in HIV incidence (-1.65%) and had the highest percentage of people living with HIV who know their HIV status (73.1%), percentage of people living with HIV who are on ART (44.4%), and highest percentage of people living with HIV with suppressed viral loads (64.4%). By contrast, countries with the lowest income inequality demonstrated the lowest reduction in HIV incidence (-.52), the

lowest percentage of people living with HIV who know their status (73.1%), percentage of people living with HIV who are on ART (44.4%), and percent of people living with HIV who have suppressed viral loads (49.3%).

Partially-free countries experienced the greatest reduction in HIV incidence (-0.72%). Free countries had the highest percentages of people living with HIV who know their HIV status (70.3%) and percent of people living with HIV who are on ART (42.7%). Countries considered not free had the highest percentage of people living with HIV with suppressed viral loads (60.3%).

Countries in population tertile one, those with the lowest populations, demonstrated the greatest reduction in HIV incidence between 2010 and 2019 (-0.93%), while countries in the largest population tertile experienced the smallest decrease in HIV incidence (-0.48%). Countries in population tertile two had the highest percentage of people on HIV who know their HIV status (68.1%) and the highest percentage of people living with HIV who are on ART (38.7%). Countries in population tertile three, those with the highest population, had the highest percentage of people living with HIV who had suppressed viral loads (60.9%).

PEPFAR countries demonstrated a greater decrease in HIV incidence between 2010-2019 when compared to non-PEPFAR countries (-2.09% vs -0.12%). Similarly, when comparing dependent variables between PEPFAR and non-PEPFAR countries, PEPFAR countries had a higher percentage of people living with HIV who know their HIV status (78.2% vs 60.9%), a higher percentage of people living with HIV who are on ART (50.4% vs 33.2%), and a higher percentage of people living with HIV who have suppressed viral loads (68.1% vs 49.1%).

Countries with the lowest degree of fiscal, political, and administrative decentralization demonstrated the greatest reduction in HIV incidence between 2010 and 2019 (-0.73%, -1.05%,

and -0.99%, respectively) and had the highest percentages of people living with HIV who have suppressed viral loads (59.1%, 60.8%, and 58.4%, respectively). Countries with mid-levels of fiscal decentralization (tertile two) had the highest percentage of people living with HIV who know their status (64.9%) and percentage of people living with HIV who are on ART (40.2%). Countries with the highest degree of political and administrative decentralization had the highest percentage of people living with HIV who know their status (69.2% and 72.8%, respectively) and percentage of people living with HIV who are on ART (40.7% and 39.7%, respectively).

Regression Estimates

See Appendix F: Summary Table of Regression Estimates for an overview of the regression estimates by outcome.

Reduction in HIV Incidence

Table 8 shows the regression estimates (with p-values) for the fiscal decentralization model for reduction in HIV incidence between 2010 and 2019 in LMICs. After accounting for Gini, which was the only statistically significant confounder in the univariate model, the multivariate ordinary least squares regression model suggests that LMICs with PEPFAR programs experienced a significantly higher reduction in HIV incidence per 1000 population than those without. These findings align with evidence supporting the efficacy of PEPFAR when it comes to decreasing new HIV infections and controlling the HIV epidemic (PEPFAR, 2021b).

Table 8 is suggestive of a relationship between fiscal decentralization, PEPFAR, and reduction in HIV incidence. LMICs in the highest fiscal decentralization tertile that had PEPFAR programs demonstrated significantly higher reductions in new HIV infections between 2010 and

2019 than did LMICs in the lowest decentralization tertile without PEPFAR programs (-3.39 (p=< 0.001)). Non-PEPFAR countries had comparatively low levels of HIV, but there was not a relationship with decentralization. This suggests that PEPFAR countries with a high degree of fiscal decentralization (tertile 3) appear to be more successful at decreasing HIV incidence than PEPFAR countries with lesser degrees of fiscal decentralization (tertiles 1 and 2) (Figure 9). LMICs without PEPFAR programs experienced smaller reductions in HIV incidence as compared to LMICs with PEPFAR programs, or PEPFAR countries (Table 8). Figure 9 highlights the inverse relationship between fiscal decentralization and reduction in HIV incidence in countries with PEPFAR programs when compared those without. Less fiscally decentralized non-PEPFAR countries appear to be more successful at decreasing HIV incidence than more fiscally decentralized non-PEPFAR countries.

Table 8: Estimates from the Multivariate Ordinary Least Squares Linear Regression Model of Reduction in HIV Incidence per 1000 Population for 2019 Minus 2010, Fiscal Decentralization

Reduction in HIV incidence per 1000 population for 2019 minus 2010		
	Level	Estimate (p-value)
(Intercept)		0.0407 (p=0.90136)
Gini ^a	Q2 vs Q1	-0.166 (p=0.62579)
	Q3 vs Q1	-0.134 (p=0.71014)
	Q4 vs Q1	-0.833 (p=0.03301)*
PEPFAR ^b	PEPFAR vs Not PEPFAR	-1.14 (p=0.00462)*
Fiscal Decentralization ^c	Tertile 2 vs Tertile 1	-0.0428 (p=0.90216)
	Tertile 3 vs Tertile 1	0.216 (p=0.51578)
PEPFAR * Fiscal Decentralization ^d	PEPFAR and Tertile 2	-0.411 (p=0.47454)
	PEPFAR and Tertile 3	-3.39 (p=< 0.001)*

^a Reference is quartile 1. ^b Reference is not PEPFAR. ^c Reference is tertile 1. ^d Reference is not PEPFAR and tertile 1.

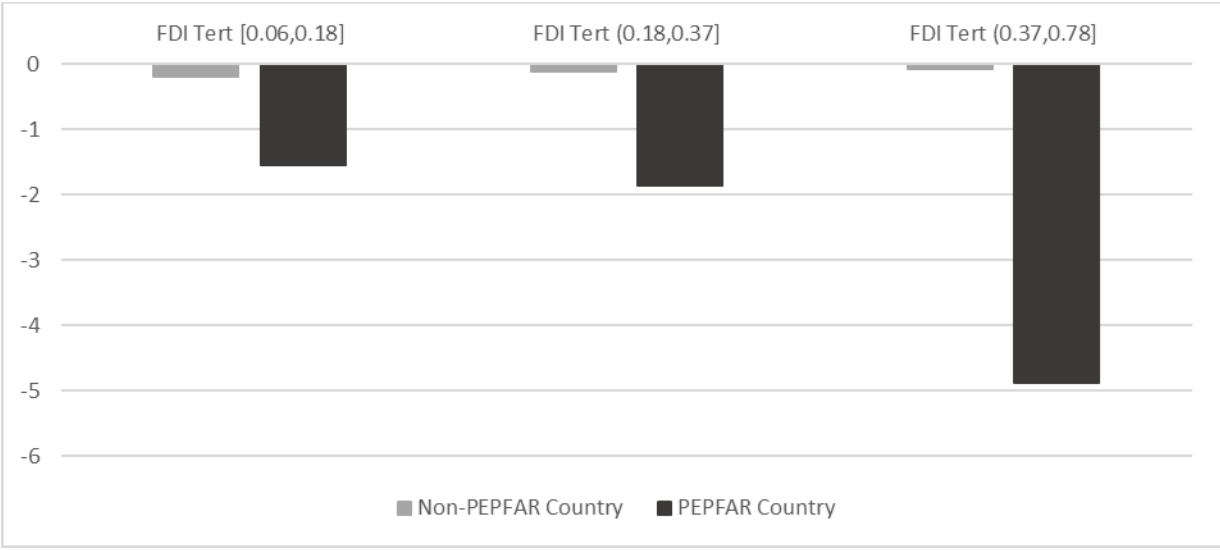


Figure 9: Reduction in HIV Incidence, 2019 Minus 2010, by Fiscal Decentralization Tertile

Table 9 shows the regression estimates (with p-values) for the political decentralization model for reduction in HIV incidence between 2010 and 2019 in LMICs. LMICs without PEPFAR programs have significantly lower reduction in HIV incidence when compared to LMICs with PEPFAR programs, or PEPFAR countries (Table 9). The relationship between political decentralization and reductions in HIV incidence were observed to be statistically significant, with the least politically decentralized LMICs (tertile 1; both PEPFAR and non-PEPFAR) showing the greatest reduction in HIV incidence (2019 minus 2010) when compared to the most politically decentralized countries (tertiles 3; 0.796 (p=0.01823) (see Figure 10). Since the interaction with PEPFAR was not significant in the model, the model was refitted with the main effects of political decentralization and PEPFAR removed. Administrative decentralization was not statistically significant in the model for the reduction of HIV incidence.

Table 9: Estimates from the Multivariate Ordinary Least Squares Linear Regression Model of Reduction in HIV Incidence per 1000 Population for 2019 Minus 2010, Political Decentralization

Dependent Variable	Level	Estimate (p-value)
(Intercept)		-0.101 (p=0.73311)
Gini ^a	Q2 vs Q1	-0.228 (p=0.53840)
	Q3 vs Q1	-0.389 (p=0.32804)
	Q4 vs Q1	-1.11 (p=0.00704)*
PEPFAR ^b	PEPFAR vs Not PEPFAR	-1.7 (p=< 0.001)*
Political Decentralization ^{c, d}	Tertile 2 vs Tertile 1	0.293 (p=0.33755)
	Tertile 3 vs Tertile 1	0.796 (p=0.01823)*

^a Reference is quartile 1. ^b Reference is not PEPFAR. ^c Reference is tertile 1. ^d Interaction term with PEPFAR was not statistically significant and is therefore removed from model.

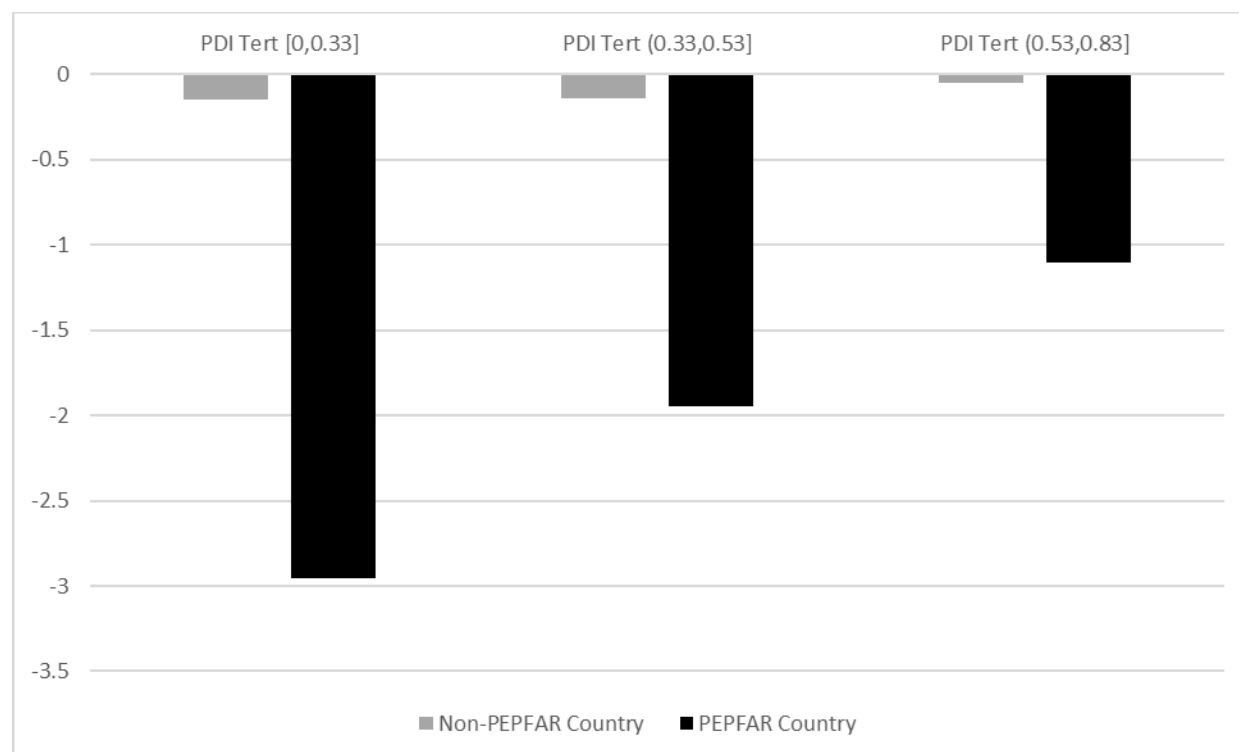


Figure 10: Reduction in HIV Incidence, 2019 Minus 2010, by Political Decentralization Tertile

Percentage of People of All Ages Who Know Their HIV Status

Table 10 shows the estimates from the panel regression fiscal decentralization model for the percentage of people who know their HIV status. After accounting for Gini and government

effectiveness, LMICs with PEPFAR programs have a significantly higher percentage of people who know their HIV status when compared to non-PEPFAR LMICs (18.2 ($p < 0.001$)). LMICs with mid-levels of fiscal decentralization (tertile 2) are significantly more likely to have a higher percentage of people who know their HIV status than countries in the lowest tertile (tertile 1). However, countries in the highest decentralization tertile (tertile 3) do not have a significantly higher percentage of people who know their HIV status when compared to LMICs in tertile 2. The interaction term with PEPFAR was not statistically significant and was therefore removed from the model; thus, using this analysis, PEPFAR did not seem to moderate the relationship between fiscal decentralization and percentage of people who know their HIV status. Neither administrative nor political decentralization were statistically significant in the model for the percentage of people who know their status.

Table 10: Estimates from the Panel Regression Model of Percentage of People of All Ages Who Know Their HIV Status (Time Series 2015-2019), Fiscal Decentralization

Variable	Level	Estimate (p-value)
(Intercept)		46.6 ($p < 0.001$)*
Gini ^a	Q2 vs Q1	7.08 ($p=0.01795$)*
	Q3 vs Q1	4.61 ($p=0.15555$)
	Q4 vs Q1	4.52 ($p=0.18863$)
Government Effectiveness ^b	Q2 vs Q1	3.75 ($p=0.07949$)
	Q3 vs Q1	6.37 ($p=0.00924$)*
	Q4 vs Q1	10.9 ($p < 0.001$)*
PEPFAR ^c	PEPFAR vs Not PEPFAR	18.2 ($p < 0.001$)*
Fiscal Decentralization ^{d,e}	Tertile 2 vs Tertile 1	8.36 ($p=0.04178$)*
	Tertile 3 vs Tertile 1	5.45 ($p=0.22628$)

^a Reference is quartile 1. ^b Reference is quartile 1. ^c Reference is not PEPFAR. ^d Reference is tertile 1. ^e Interaction term with PEPFAR was not statistically significant and is therefore removed from model.

Percentage of People of All Ages Living with HIV Receiving ART

When accounting for Gini, LMIC with PEPFAR programs have a significantly higher percentage of people living with HIV who are receive ART when compared to non-PEPFAR

LMIC (18.4 ($p < 0.001$)). Table 11 shows more fiscally decentralized LMICs have a significantly higher percentage of people living with HIV receiving ART (countries in tertile 3 vs. tertile 1 (8.44 ($p = 0.01470$)) and tertile 2 vs. tertile 1 (7.63 ($p = 0.03014$)). There was no interaction with PEPFAR for fiscal decentralization and percentage of people living with HIV receiving ART. Figure 11 highlights the relationship between fiscal decentralization and percentage of people living with HIV receiving ART. The interaction term with PEPFAR was not statistically significant and was therefore removed from model; thus, using this analysis, PEPFAR did not seem to moderate the relationship between fiscal decentralization and percentage of people living with HIV receiving ART.

Figure 12 highlights the relationship between political decentralization and percentage of people living with HIV on ART, in both PEPFAR and non-PEPFAR countries. For PEPFAR countries, there appears to be a negative relationship between political decentralization and the dependent variable. PEPFAR countries with less political decentralization have significantly more people living with HIV on ART than PEPFAR countries with higher degrees of political decentralization (Figure 12). Although not statistically significant, the opposite appears to hold for non-PEPFAR countries (Figure 11). Non-PEPFAR countries that are more politically decentralized have more people living with HIV on ART.

A significant interaction effect was observed between PEPFAR and political decentralization and percentage of people living with HIV receiving ART (Table 12), suggesting that PEPFAR may play a moderating role in the relationship between political decentralization and the percentage of people on ART. Administrative decentralization was not statistically significant in the model for the percentage of people of all ages living with HIV receiving ART.

Table 11: Estimates from the Panel Regression Model of Percentage of People of All Ages Living with HIV Receiving ART (Time Series 2010-2019), Fiscal Decentralization

Variable	Level	Estimate (p-value)
(Intercept)		22.5 (p=< 0.001)*
Gini ^a	Q2 vs Q1	9.9 (p=< 0.001)*
	Q3 vs Q1	9.6 (p=0.00118)*
	Q4 vs Q1	2.31 (p=0.47794)
PEPFAR ^b	PEPFAR vs Not PEPFAR	18.4 (p=< 0.001)*
Fiscal Decentralization ^{c,d}	Tertile 2 vs Tertile 1	7.36 (p=0.03014)*
	Tertile 3 vs Tertile 1	8.44 (p=0.01470)*

^a Reference is quartile 1. ^b Reference is not PEPFAR. ^c Reference is tertile 1. ^d Interaction term with PEPFAR was not statistically significant and is therefore removed from model.

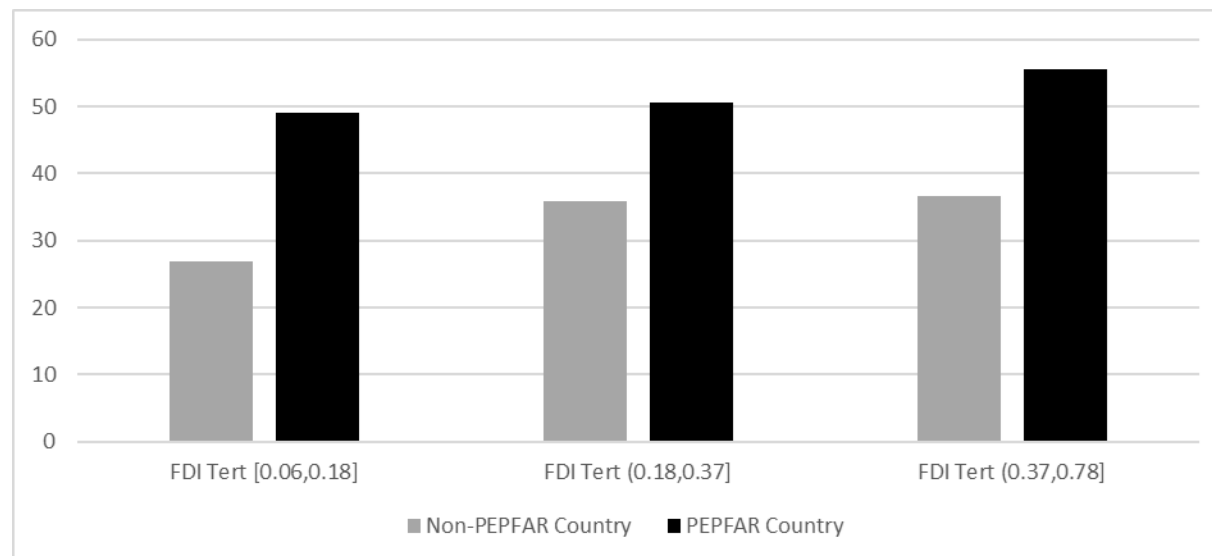


Figure 11: Relationship Between Fiscal Decentralization and Percentage of People Living with HIV on ART in LMICs, PEPFAR Countries and Non-PEPFAR Countries

Table 12: Estimates from the Panel Regression Model of Percentage of People of All Ages Living with HIV Receiving ART (Time Series 2010-2019), Political Decentralization

Variable	Level	Estimate (p-value)
(Intercept)		26.5 (p=< 0.001)*
Gini ^a	Q2 vs Q1	8.77 (p=0.00100)*
	Q3 vs Q1	7.99 (p=0.00913)*
	Q4 vs Q1	-0.28 (p=0.93394)
	PEPFAR vs Not PEPFAR	23.5 (p=< 0.001)*
Political Decentralization ^c	Tertile 2 vs Tertile 1	0.517 (p=0.89829)
	Tertile 3 vs Tertile 1	8.12 (p=0.06355)
PEPFAR * Political Decentralization ^d	PEPFAR and Tertile 2	-4.12 (p=0.60290)
	PEPFAR and Tertile 3	-16.3 (p=0.04684)*

^a Reference is quartile 1. ^b Reference is not PEPFAR. ^c Reference is tertile 1. ^d Reference is not PEPFAR and tertile 1.

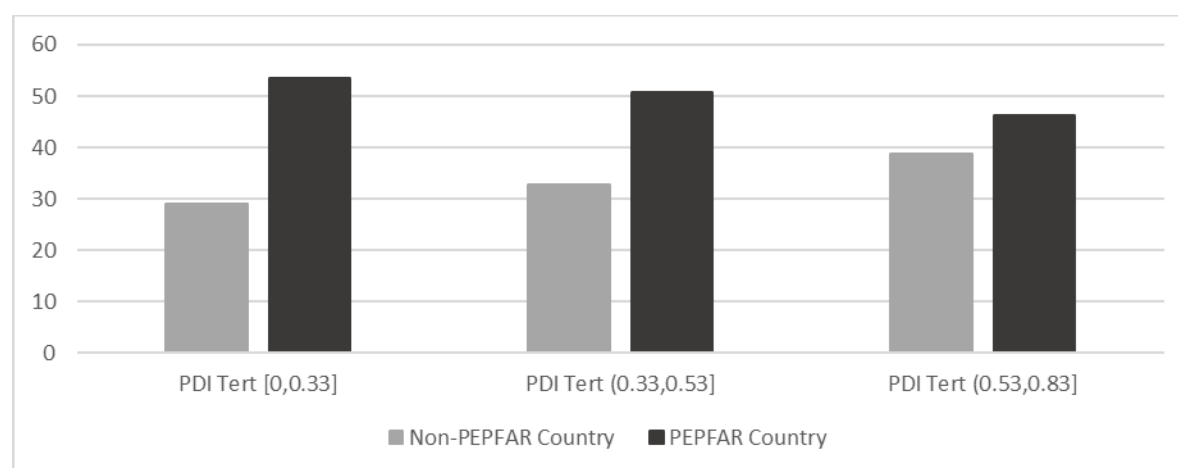


Figure 12: Relationship Between Political Decentralization and Percentage of People Living with HIV on ART in LMICs, PEPFAR Countries and Non-PEPFAR Countries

Percentage of People of All Ages Living with HIV Who Have Suppressed Viral Loads

Table 13 highlights the estimates from the model exploring the relationship between fiscal decentralization and percentage of people living with HIV who have viral load suppressions. Both Gini and income group were significant in the univariate model and were therefore included in the multivariate model, leading to the observation of a significant PEPFAR effect. PEPFAR countries have a significantly higher percentage of people living with HIV who

have suppressed viral loads 15.6 ($p < 0.001$). Fiscal decentralization, the main effect, was not significant in the model for percentage of people living with HIV who have suppressed viral loads. The interaction term with PEPFAR was not statistically significant and was therefore removed from model. Thus, using this analysis, PEPFAR did not seem to moderate the relationship between fiscal decentralization and percentage of people of all ages living with HIV who have suppressed viral loads. Neither administrative nor political decentralization were statistically significant in the model for the percentage of people of all ages living with HIV who have suppressed viral loads.

Table 13: Estimates from the Multivariate Ordinary Least Squares Linear Regression Model of Percentage of People of All Ages Living with HIV Who Have Suppressed Viral Loads (2019), Fiscal Decentralization

Variable	Level	Estimate (p-value)
(Intercept)		53.6 ($p < 0.001$)*
Gini ^a	Q2 vs Q1	-1.49 ($p = 0.7863$)
	Q3 vs Q1	-1.07 ($p = 0.8389$)
	Q4 vs Q1	10 ($p = 0.0611$)
Income Group ^b	Lower middle income	-6.87 ($p = 0.2070$)
	Upper middle income	-10.5 ($p = 0.0934$)
PEPFAR ^c	PEPFAR vs Not PEPFAR	15.6 ($p < 0.001$)*
Fiscal Decentralization ^{d, e}	Tertile 2 vs Tertile 1	4.22 ($p = 0.3524$)
	Tertile 3 vs Tertile 1	0.2 ($p = 0.9662$)

^a Reference is quartile 1. ^b Reference is lower income. ^c Reference is not PEPFAR. ^d Reference is tertile 1. ^e Interaction term with PEPFAR was not statistically significant and was therefore removed from model.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a summary of the study and important conclusions drawn from the findings presented in Chapter 4. It provides a discussion of the implications of this work on LMICs, specifically, the transition of national HIV programs from PEPFAR-supported to full country ownership and concludes with recommendations for further research.

Summary of the Study

PEPFAR aims to promote sustainability and country ownership of national HIV programs among the LMICs in which the program operates. However, PEPFAR's structure and approach may be antagonistic to this goal. Successful HIV responses in LMICs may be benefiting from PEPFAR's centralized funding, administration, policy-support, and technical assistance, which runs counter to the implementation of national decentralization efforts in these nations. The unintended consequence of this dichotomy could be the inability of countries to achieve and sustain HIV treatment goals in the absence of PEPFAR. The main thesis of this study is that HIV outcomes in LMICs are influenced by the country's degree of fiscal decentralization: however, the effects of fiscal decentralization on HIV treatment may be masked in LMICs with PEPFAR programs, because PEPFAR centralizes national HIV response efforts in the countries in which it operates.

In response to this concern, the current study was designed to determine if there is a negative relationship between fiscal decentralization and HIV outcomes in low- and middle-income countries, and to examine whether the effects of fiscal decentralization on HIV outcomes are changed when PEPFAR is present. This research explored the three research questions below. Though questions two and three represent the primary research questions of interest for the

study, it was first necessary to establish that PEPFAR was effective at controlling HIV epidemics in LMICs, hence research question one.

1. Are LMICs with PEPFAR programs better at controlling their HIV epidemics than LMICs without PEPFAR programs?
 - a. Did LMICs with PEPFAR programs experience greater reductions in HIV incidence (2010-2019) than LMICs without?
 - b. Did LMICs with PEPFAR programs experience significantly greater reductions in the treatment cascade variables than LMICs without?
2. Do LMICs that have higher degrees of fiscal decentralization have better HIV treatment outcomes than less decentralized LMICs?
 - a. Is there a positive or negative relationship between fiscal decentralization and HIV treatment outcomes in LMICs?
3. Does the presence of PEPFAR change the relationship between fiscal decentralization and HIV treatment outcomes in LMICs?
 - a. Is the relationship between fiscal decentralization and HIV treatment outcomes different in LMICs with PEPFAR-supported HIV programs when compared to LMICs without PEPFAR-supported HIV programs?

This cross-national econological study hypothesized a negative relationship between fiscal decentralization and the HIV treatment cascade outcomes in LMICs (i.e., countries with higher levels of decentralization will have worse HIV outcomes when compared to countries with lower levels of decentralization). This negative relationship, it was proposed, is reduced when PEPFAR is present (i.e., PEPFAR minimizes this negative effect). To test this hypothesis, the study used an ordinary least squares multiple linear regression and panel regression analysis

to establish the efficacy of LMICs at controlling their HIV epidemics and to identify relationships between the three independent variables (fiscal decentralization (primary independent variable of interest), administrative decentralization, and political decentralization) and the four dependent variables (reduction of HIV incidence per 1000 population all ages (2010-2019), percentage of people all ages living with HIV who know their status, percentage of people of all ages living with HIV receiving antiretroviral therapy (ART), and percentage of people of all ages living with HIV who have suppressed viral loads).

Panel data (see Table 5) was integrated into a single dataset by matching independent variables to the dependent variables by country and year. Countries included in 2019 UNAIDS data were selected for inclusion in the dataset ($n=172$). After the application of exclusion criteria (high income countries, countries with population <one million, and countries missing data for the independent or confounding variables), the dataset comprised 96 countries ($n=96$). Next, four analytical datasets were created, one for each of the independent variables (see Figure 3). Importantly, while 10 years of data was available for percentage of people all ages living with HIV who know their status and percentage of people of all ages living with HIV receiving antiretroviral therapy (ART), only five years of data was available for percentage of people living with HIV who are virally suppressed (Figure 3). Due to the uncertainty of a continuous relationship between the confounding, dependant, and independant variables, the confounding and independent variables were transformed into categorical variables.

Descriptive statistics were used to generate histograms, scatter plots, and a calculated variable to represent the change in HIV incidence between 2010-2019. Subsequently, ordinary least squares multiple linear regression using time series data was used to relate measure of decentralization to the HIV outcomes. PEPFAR was included in the model as an interaction,

which allowed the study to explore the the effect of PEPFAR on the relationship between decentralization and HIV outcomes. See Chapter 3 for more details on methods and analysis. All findings from this study should be considered in the context of the limitations associated with cross-national, ecological studies. A comprehensive list of these limitations can be found on page 60 of this dissertation.

Synopsis of the Main Findings

Question 1. Are LMICs with PEPFAR programs better at controlling their HIV epidemics than LMICs without PEPFAR programs?

LMICs that have PEPFAR country programs are better at controlling their HIV epidemics than those without. PEPFAR countries experienced a statistically significantly larger reduction in HIV incidence between 2010 and 2019 than did countries that do not have PEPFAR programs. PEPFAR countries also demonstrated statistically significant reductions in the treatment cascade variables (percentage of people all ages living with HIV who know their status, percentage of people of all ages living with HIV receiving antiretroviral therapy (ART), and percentage of people of all ages living with HIV who have suppressed viral loads) when compared to non-PEPFAR countries.

It is important to note that LMICs with PEPFAR country programs also had the highest burden of HIV incidence: non-PEPFAR countries could not achieve reductions of the same magnitude as those experienced by some of the PEPFAR countries. Countries with populations lower than one million were excluded from the analysis. In the case of the treatment cascade variables, PEPFAR countries have higher numbers of people with HIV as well as higher percentages of people diagnosed with HIV, on ART, and with sustained viral load suppression. Using reductions in HIV incidence between 2010 and 2019, as well as reductions in the three

treatment cascade variables, as measures of efficacy, this study demonstrated that LMICs with PEPFAR country programs were more effective at controlling their HIV epidemics than non-PEPFAR countries.

Question 2. Do LMICs that have higher degrees of fiscal decentralization have better HIV treatment outcomes than less decentralized LMICs?

LMICs with higher degrees of fiscal decentralization had better HIV treatment outcomes than less fiscally decentralized LMICs for two out of the three treatment cascade outcomes. In the adjusted models, higher degrees of fiscal decentralization appear to be associated with a higher percentage of people who know their HIV status and a higher percentage of people on ART. There were no statistically significant findings related to the relationship between fiscal decentralization and viral load suppression across LMICs, which could be related to the small sample size. The findings from the adjusted regression models are the opposite of what was observed in the unadjusted models, whereby less fiscal decentralization was associated with better HIV treatment outcomes.

Question 3. Does the presence of PEPFAR affect the relationship between fiscal decentralization and HIV treatment outcomes in LMICs?

The presence of PEPFAR does not appear to change the relationship between fiscal decentralization and HIV treatment outcomes in LMICs. There was no significant interaction effect observed between PEPFAR and fiscal decentralization for any of the three HIV treatment or HIV cascade variables. This suggests that PEPFAR does not moderate the relationship between fiscal decentralization and HIV treatment cascade outcomes: However, it is important to note that interaction effects were observed between PEPFAR and fiscal decentralization for reduction in HIV incidence (2010-2019) and PEPFAR and political

decentralization for people living with HIV receiving ART. These findings are discussed further in the unexpected findings section of this chapter and suggest that it would be premature to conclude that PEPFAR does not have a centralizing effect based solely on a lack of observed interaction between PEPFAR and fiscal decentralization for any of the three HIV cascade variables.

Support for the Hypothesis

This study hypothesized a negative relationship between fiscal decentralization and the HIV treatment cascade outcomes in LMICs, proposing that the presence of PEPFAR would reduce the effect of this negative relationship. Although the unadjusted findings supported the hypothesized direction of the relationship between fiscal decentralization and the the three HIV treatment cascade outcomes (Table 7), when accounting for confounders, the regression models do not support the hypothesis. In fact, the results support the opposite, or alternative, hypothesis for two of the three HIV treatment cascade outcomes. When adjusting for confounders, a positive relationship was observed between all LMICs with higher degrees of fiscal decentralization and the percentage of people living with HIV who know their HIV status and are on ART in those countries. This analysis suggests that LMICs with higher degrees of fiscal decentralization appear to be better at identifying people living with HIV and getting them on treatment than less fiscally decentralized LMICs. LMICs with PEPFAR programs and higher degrees of fiscal decentralization appear to be significantly better than non-PEPFAR LMICs at identifying individuals who are HIV positive and getting them onto treatment (i.e. ART).

Unexpected Findings

The statistical modeling exercise, designed to address the key research questions and hypothesis, also tested several additional questions that yielded unexpected insights. LMICs with PEPFAR programs that were more fiscally decentralized experienced significantly greater reductions in HIV incidence when compared to LMICs with PEPFAR programs that were less fiscally decentralized. Inversely, LMICs with PEPFAR programs that were less politically decentralized experienced greater reductions in HIV incidence compared to their equivalents that were more politically decentralized. A similar inverse pattern was observed for the relationship between fiscal and political decentralization for one of the HIV cascade outcomes, percentage of people of all ages living with HIV receiving ART.

PEPFAR, as a bilateral mechanism, is structured in such a way that outcomes should be maximized when working at the central level. Therefore, the finding that the program is more successful at controlling HIV in LMICs with less political decentralization, on its own, is not unexpected. What is unexpected is that PEPFAR appears better at controlling HIV incidence and getting HIV-positive individuals on to HIV treatment in LMICs that are simultaneously less politically and more fiscally decentralized. The similar pattern observed for the outcomes of reduction in HIV incidence (though, not significant) and the percentage of people of all ages living with HIV receiving ART could suggest that PEPFAR works optimally in a country with low political decentralization and high fiscal decentralization. One could hypothesize that PEPFAR performs best when 1) it does not have to solicit and manage political buy-in across sub-national levels, and 2) when existing sub-national levels have capacity and autonomy to distribute and manage funding at the local level. This inverse relationship between political and

fiscal decentralization in the context of HIV epidemic control is both interesting and unexplored in the literature to date.

The second unexpected finding relates to research question three, which examined the role of PEPFAR as a moderator of fiscal decentralization and the HIV treatment cascade. The contextual framework for this study (Figure 1) suggested that PEPFAR's bi-lateral influence in LMICs would be at odds with national decentralization strategies, resulting in a centralizing effect on national HIV programs. This study used the three HIV treatment cascade variables as the outcomes of interest when exploring this problem, adding reduction in HIV incidence as a variable of secondary interest. While the main analysis did not find clear evidence to suggest that PEPFAR moderates the relationship between fiscal decentralization and the HIV treatment cascade, it appears that PEPFAR may moderate the relationship between fiscal decentralization and reduction in HIV incidence (2019 minus 2010), as well as the relationship between political decentralization and the percentage of people living with HIV receiving ART. Therefore, these results cannot rule out the idea that PEPFAR may have a centralizing effect in recipient LMICs, potentially putting PEPFAR at odds with the countries' decentralization strategies.

It is possible that this study did not select the most appropriate methods or measures to assess the moderating effect of PEPFAR on decentralization and HIV outcomes. It is important to acknowledge that HIV incidence represents population-level estimates of new HIV infections, while the HIV treatment cascade outcomes represent the percentage of individuals receiving services and/or adhering to HIV treatment regimens (i.e., a mix of individual-level and service delivery outcomes). The HIV treatment cascade variables may be more likely to represent measures of health system performance or individual-level health outcomes, while HIV incidence may better represent population-level health outcomes. In this case, the relationship

between decentralization and HIV incidence, not decentralization and the HIV treatment cascade, may be the more appropriate focus when determining the role of country-level decentralization in LMIC efforts to take over their HIV programs and sustain the progress made under PEPFAR. Given that measurement of the HIV treatment cascade began in earnest in the last eight years, it is also possible that more data on the HIV treatment cascade outcomes is needed in order to accurately assess this relationship.

Findings Related to the Literature

The existing empirical literature highlights a complicated relationship between decentralization and health outcomes, reinforced by the current study. It is important to note that the methodologic design and limitations of the current study may have influenced the findings and therefore should be considered in any comparisons with extant works.

The literature reviews conducted by Dwicaksono and Fox (2018) and Cobos Munoz (2017) observed mixed results regarding the effects of decentralization on different indicator types (i.e., population-level, or individual-level/service delivery) in LMICs. Unlike their findings, the current study found that the relationship between fiscal decentralization and reduction in HIV incidence (population-level outcomes) behaved similarly to the relationship between fiscal decentralization and two of the three HIV treatment cascade outcomes (individual-level or service delivery outcomes). In line with Cavalieri and Ferrante (2016), Dougherty and colleagues (2022), Jiménez-Rubio and García-Gómez (2017), and Robalino and other (2001), the results from the current study did identify a positive relationship between decentralization and population-level outcomes (i.e., reduction in HIV incidence); however, the current study only observed this relationship for fiscal decentralization. Unlike these works, no relationship was observed between administrative decentralization and the health outcomes of

interest. Additionally, the current study did observe a negative relationship between political decentralization and population-level health outcomes, which was not observed across any of the studies identified in the literature, possibly because few looked specifically at political decentralization.

Multiple studies from the literature explored the relationship between income group and decentralization, identifying an interaction between decentralization, population-level indicators, and income grouping in OECD countries (Cavalieri & Ferrante, 2016; Jiménez-Rubio & García-Gómez, 2017) and LMICs (Khaleghian, 2004; Soto et al., 2012). Interestingly, income group did not prove to be a significant confounder in the univariate models, and was therefore not included in the multivariate regression models for the current study. Income inequality did play a confounding role in all multivariate models for the current study. This could suggest that level of income is not as important as Gini, or income inequality, when conducting cross-national analyses that focus on decentralization and health outcomes in LMICs.

Relationships, although of varying strengths and directions across the outcomes, were observed for both political and fiscal decentralization. The models revealed no observed relationship between degree of administrative decentralization and HIV outcomes, either HIV incidence or the HIV treatment cascade outcomes, across any of the LMICs (i.e., those with or without PEPFAR programs). The complete absence of any signal related to administrative decentralization in the models may be a reflection of the complexity of defining and measuring decentralization in general (Harguindéguy et al., 2021; Rondinelli & Nellis, 1986; Triesman, 2002) and within the health sector specifically (Bossert, 1998; Dwicaksono & Fox, 2018). It could also suggest that the Ivanyna and Shah (2014) administrative decentralization measures were not robust and/or appropriate measures to use in this analysis. All of this indicates that

improved measures of decentralization, particularly administrative decentralization, are needed. Considering the HIV treatment cascade as service delivery outcomes, the findings for two of the three (the percentage of people living with HIV who know their status and the percentage of people living with HIV receiving ART) support those from studies suggesting that decentralization can improve health system performance overall (Atkinson & Haran, 2004; Regmi et al., 2010).

Some researchers argue that, to be of maximum value, a regression analysis that looks at the relationship between decentralization and health outcomes should be accompanied by comparative case studies or a decision-space analysis (Bossert, 1998; Rodden, 2004). This study did not include a comparative analysis. Despite this, its novel findings suggest a relationship between political and fiscal decentralization in the context of HIV outcomes in PEPFAR countries, and significantly expands on the current knowledge base related to the relationship between decentralization and health outcomes, particularly fiscal decentralization and HIV treatment cascade outcomes in LMICs. In addition, because the study focused on the interaction effect of PEPFAR, the largest global donor program in the world, the quantitative findings may also be relevant to other development programs.

Conclusion

PEPFAR has been effective at decreasing new HIV infections and delivering HIV services in LMICs, particularly those with higher degrees of fiscal decentralization and lower degrees of political decentralization. The role that PEPFAR plays in the relationship between decentralization and HIV outcomes in LMICs is complex and unclear. PEPFAR appears to moderate the relationship between fiscal decentralization and reduction in new HIV infections and political decentralization and HIV treatment, which could support the idea that PEPFAR may

have a centralizing effect as posited in the problem statement guiding this project. However, further analysis revealed that PEPFAR did not moderate the relationship between fiscal decentralization and any of the HIV treatment cascade outcomes. Perhaps this is explained by the difference in the nature of outcomes selected (i.e., HIV incidence vs. HIV treatment cascade), but the discrepancy warrants further consideration. When looking at the relationship between decentralization and the HIV treatment cascade in PEPFAR countries, the only moderating effect was observed between political decentralization and percentage of people with HIV who are on ART, this may suggest that PEPFAR has had to bring its considerable bi-lateral influence to bear to achieve successful ART initiation. Again, while the relationships in these models were too tenuous to draw conclusions, they do suggest that PEPFAR may have influenced the relationships between fiscal and political decentralization and HIV outcomes, and the need for future research to explore the mechanisms through which it does so.

Recommendations for Further Research

This project has revealed several opportunities for future research. Rodden (2004) suggests that, due to the empirical limits of ecological studies (e.g., ecological fallacy and the fallacy of division, limited causal inference, etc.), regression analyses attempting to measure the effect of decentralization "...are most useful when they both respond to and help inform truly comparative case studies." A comparative analysis could support or refute the quantitative findings from this analysis. One component of such a comparative analysis could focus on decentralization efforts within the health sector, and should attempt to align some of the many existing decision-space analysis undertaken across LMICs with the emerging quantitative literature related to national-level and health-sector-level decentralization efforts in LMICs.

The decentralization index used in this analysis, while not the most robust available, was the only index that included all LMICs, including PEPFAR countries (Harguindéguy et al., 2021). In addition to only capturing one time point (i.e., 2005), which is relatively out of date, the Ivanyna and Shah (2014) index was developed to assess the closeness of a government to its people, not to assess closeness of government providing or delivering health services. There is an opportunity to create an up-to-date decentralization index that includes LMICs and covers a wider time scale, and/or use an updated index to reproduce the current analysis and verify its findings.

The findings from this study indicate that different types of decentralization interact with health outcomes differently. Moving forward, future research exploring the relationship between decentralization and health outcomes, specifically HIV outcomes, should focus on discrete categories of decentralization, rather than aggregated decentralization.

Implications and Recommendations for PEPFAR and the Sustainability of National HIV

Programs

This results of this research have the following implications for PEPFAR and the transition of national HIV programs to country ownership.

1. Achievement of the 95-95-95 goals, as measured through the HIV treatment cascade, may not translate into HIV epidemic control, as measured through a reduction in HIV incidence. As observed in the literature and supported by the current findings, changes in population measures of HIV control, such as reduction in HIV incidence, are not always reflective of individual and service-delivery outcomes (e.g., the HIV clinical cascade).

2. Expanding the operational framework of PEPFAR to include political economy of health concepts could enable PEPFAR to identify political and economic barriers that could be impeding sustainability efforts (e.g., the unintended consequences of PEPFAR).

The findings from this research yielded the following recommendations for PEPFAR.

1. PEPFAR should make a concerted effort to understand both the current health sector decentralization policies and the national decentralization strategies in the countries in which it operates.
2. PEPFAR should leverage existing research and support additional country-level inquiries to build on the findings of this study and explore the relationship between HIV programs and both health-sector and national fiscal and political decentralization strategies in the countries in which it operates.
3. PEPFAR should engage partner country stakeholders to identify opportunities to strengthen alignment between PEPFAR and the national-level and health sector-specific fiscal and political decentralization strategies and policies in the countries in which it operates.

Concluding Remarks

The degree of fiscal decentralization in a low/middle-income country may influence its ability to control an HIV epidemic. Countries that have higher degree of fiscal decentralization appear better placed to reduce new HIV infections and enroll HIV-positive persons onto ART. The relationship between fiscal decentralization and the ability of a country to identify HIV-positive individuals and guide them to achieve viral load suppression is less clear. As LMICs seek to assume control of their national HIV responses and achieve and sustain gains toward epidemic

control under PEPFAR, increased emphasis should be placed on understanding the relationship between national decentralization policies and their effects on health system policies and outcomes. Both PEPFAR and LMICs seeking to assume full control over their national HIV programs should identify opportunities to leverage existing political systems and maximize current decentralization policies to support these efforts.

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APPENDIX A: PEPFAR-SUPPORTED COUNTRIES BY PEPFAR FUNDING LEVEL AND
FISCAL DECENTRALIZATION TERTILE

PEPFAR Funding Level	PEPFAR-Supported Country ^a	Fiscal Decentralization Tertile ^b	
PEPFAR represents 66% or greater of the national HIV program budget	Botswana	Tertile 1	
	Cameroon		
	Cote d'Ivoire		
	Democratic Republic of Congo		
	Haiti		
	Malawi	Tertile 2	
	Eswatini		
	Nigeria		
	Tanzania		
	Uganda		
PEPFAR represents between 30% and 65% of the national HIV program budget	Zambia	Tertile 3	
	Lesotho		
	Burundi	Tertile 1	
			Namibia
			Rwanda
			Vietnam
			Zimbabwe
	Ethiopia	Tertile 2	
			Kenya
			Ukraine
Mozambique			Tertile 3
South Africa			

^a Angola and Dominican Republic missing PEPFAR funding data. ^b South Sudan missing decentralization data.

APPENDIX B: ANALYTIC DATASETS BY COUNTRY

Country (N=96)	2010-2019 HIV incidence dataset (n = 81)	2015-2019 HIV status dataset (n = 72)	Countries with 2010-2015 ART dataset (n = 88)	2019 viral load suppression dataset (n = 49)
Afghanistan	X		X	
Albania	X	X	X	X
Algeria	X	X	X	X
Angola	X	X	X	
Argentina	X		X	
Armenia				
Azerbaijan	X	X	X	X
Bangladesh		X	X	
Belarus	X	X	X	X
Benin	X	X	X	
Bolivia (Plurinational State of)	X		X	X
Bosnia and Herzegovina				
Botswana	X	X	X	X
Brazil	X	X	X	X
Bulgaria	X	X	X	X
Burkina Faso	X	X	X	
Burundi	X	X	X	
Cameroon	X	X	X	
Chad	X	X	X	
China				
Colombia	X	X	X	X

Country (N=96)	X 2010-2019 HIV incidence dataset (n = 81)	X 2015-2019 HIV status dataset (n = 72)	X Countries with 2010- 2015 ART dataset (n = 88)	2019 viral load suppression dataset (n = 49)
Costa Rica	X	X	X	
Côte d'Ivoire	X	X	X	X
Djibouti	X		X	
Dominican Republic	X	X	X	X
Ecuador	X	X	X	X
Egypt		X	X	
El Salvador	X	X	X	X
Eswatini	X	X	X	X
Ethiopia	X	X	X	X
Gabon	X	X	X	
Georgia	X	X	X	X
Ghana	X	X	X	X
Guatemala	X	X	X	X
Guinea	X	X	X	
Guinea-Bissau	X	X	X	
Haiti	X	X	X	X
Honduras	X	X	X	X
India	X	X	X	X
Indonesia	X		X	
Iran (Islamic Republic of)	X	X	X	
Iraq				
Jordan				
Kazakhstan	X	X	X	X
Kenya	X	X	X	X
Kyrgyzstan	X	X	X	X

Country (N=96)	2010-2019 HIV incidence dataset (n = 81)	2015-2019 HIV status dataset (n = 72)	Countries with 2010-2015 ART dataset (n = 88)	2019 viral load suppression dataset (n = 49)
Lao People's Democratic Republic	X		X	
Lebanon	X	X	X	X
Lesotho	X	X	X	X
Liberia		X	X	
Madagascar	X	X	X	
Malawi	X	X	X	X
Malaysia	X	X	X	
Mali	X	X	X	
Mauritania	X	X	X	
Mauritius	X	X	X	X
Mexico	X		X	X
Mongolia	X		X	
Morocco	X	X	X	X
Mozambique	X	X	X	X
Myanmar	X		X	X
Namibia	X	X	X	X
Nepal		X	X	X
Nicaragua	X		X	X
Niger	X	X	X	X
Nigeria	X	X	X	X
Pakistan		X	X	
Paraguay	X		X	
Peru	X		X	
Philippines	X	X	X	

Country (N=96)	2010-2019 HIV incidence dataset (n = 81)	2015-2019 HIV status dataset (n = 72)	Countries with 2010-2015 ART dataset (n = 88)	2019 viral load suppression dataset (n = 49)
Republic of Moldova	X	X	X	X
Russian Federation				
Rwanda	X	X	X	X
Senegal	X	X	X	X
Serbia	X	X	X	
Sierra Leone	X	X	X	
Somalia			X	
South Africa	X	X	X	X
Sri Lanka	X	X	X	X
Sudan	X	X	X	
Tajikistan	X	X	X	X
Thailand	X		X	
Timor-Leste	X	X	X	
Togo	X	X	X	
Tunisia	X	X	X	
Turkey				
Turkmenistan				
Uganda	X	X	X	X
Ukraine	X	X	X	X
United Republic of Tanzania	X	X	X	X
Uzbekistan	X	X	X	
Venezuela (Bolivarian Republic of)			X	
Viet Nam	X		X	X
Yemen	X	X	X	

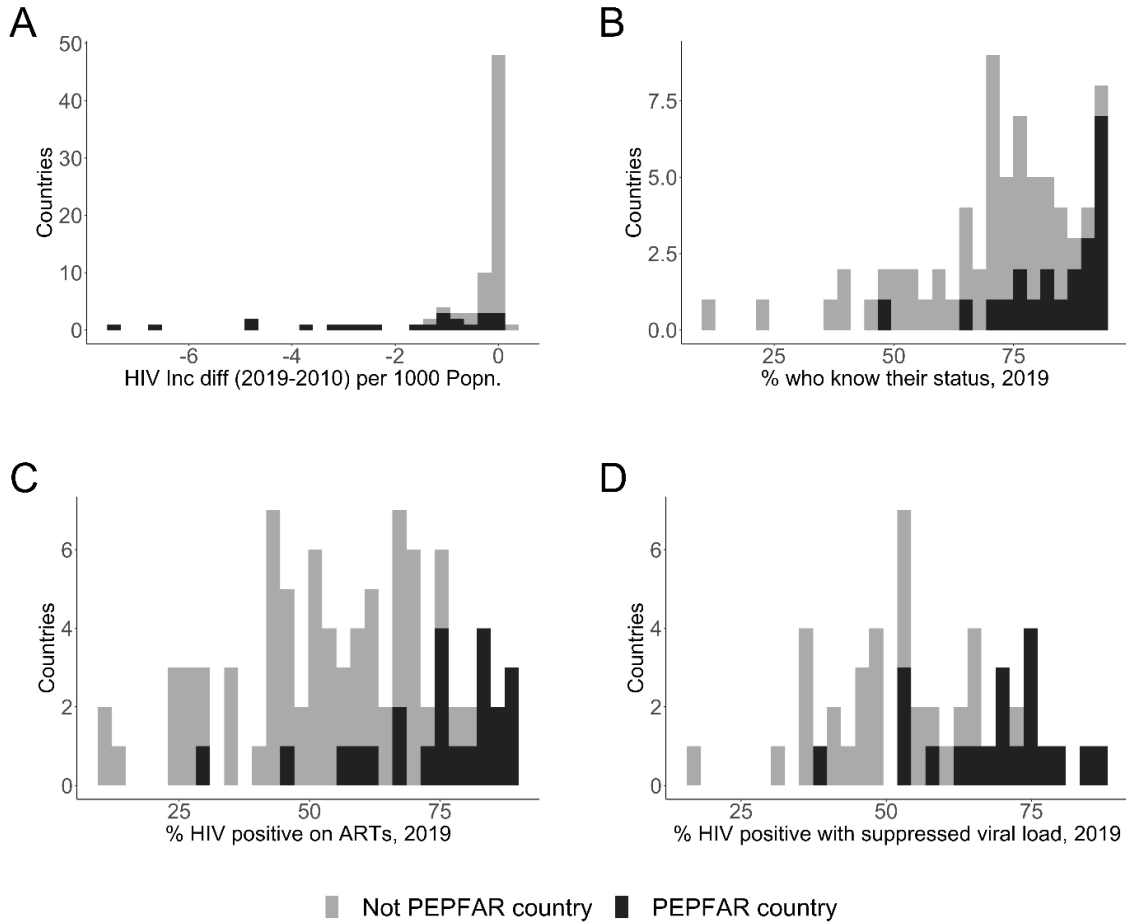
Country (N=96)	2010-2019 HIV incidence dataset (n = 81)	2015-2019 HIV status dataset (n = 72)	Countries with 2010-2015 ART dataset (n = 88)	2019 viral load suppression dataset (n = 49)
Zambia	X	X	X	X
Zimbabwe	X	X	X	X

APPENDIX C: PEPFAR COUNTRY BY DECENTRALIZATION TERTILES

Country	Fiscal Decentralization Score	Fiscal Decentralization Tertile	Political Decentralization Score	Political Decentralization Tertile*	Administrative Decentralization Score	Administrative Decentralization Tertile*
Angola	0.14	1	0	1	0.07	2
Botswana	0.16	1	0.33	1	0.37	3
Burundi	0.14	1	0.33	1	0.05	1
Cameroon	0.12	1	0.42	2	0.05	1
Cote d'Ivoire	0.13	1	0.39	2	0.27	2
Dominican Republic	0.14	1	0.58	3	0.04	1
Democratic Republic of Congo	0.12	1	0.17	1	0.05	1
Eswatini	0.22	2	0.13	1	0.03	1
Ethiopia	0.36	2	0.5	2	0.45	3
Haiti	0.06	1	0	1	0	1
Kenya	0.36	2	0.33	2	0.15	2
Lesotho	0.38	3	0	1	0.03	1
Malawi	0.13	1	0.67	3	0	1
Mozambique	0.41	3	0.17	1	0	1
Namibia	0.11	1	0.58	3	0.28	2
Nigeria	0.24	2	0.67	3	0.2	2
Rwanda	0.08	1	0.53	3	0.04	1
South Africa	0.58	3	0.42	2	0.4	3
South Sudan	NA	-	NA	-	NA	-

Country	Fiscal Decentralization Score	Fiscal Decentralization Tertile	Political Decentralization Score	Political Decentralization Tertile	Administrative Decentralization Score	Administrative Decentralization Tertile
Tanzania	0.2	2	0.75	3	0.49	3
Uganda	0.21	2	0.5	2	0.32	2
Ukraine	0.35	2	0.64	3	0.74	3
Vietnam	0.16	1	0.58	1	0.55	3
Zambia	0.31	2	0.25	1	0.13	2
Zimbabwe	0.17	1	0.42	2	0.1	2

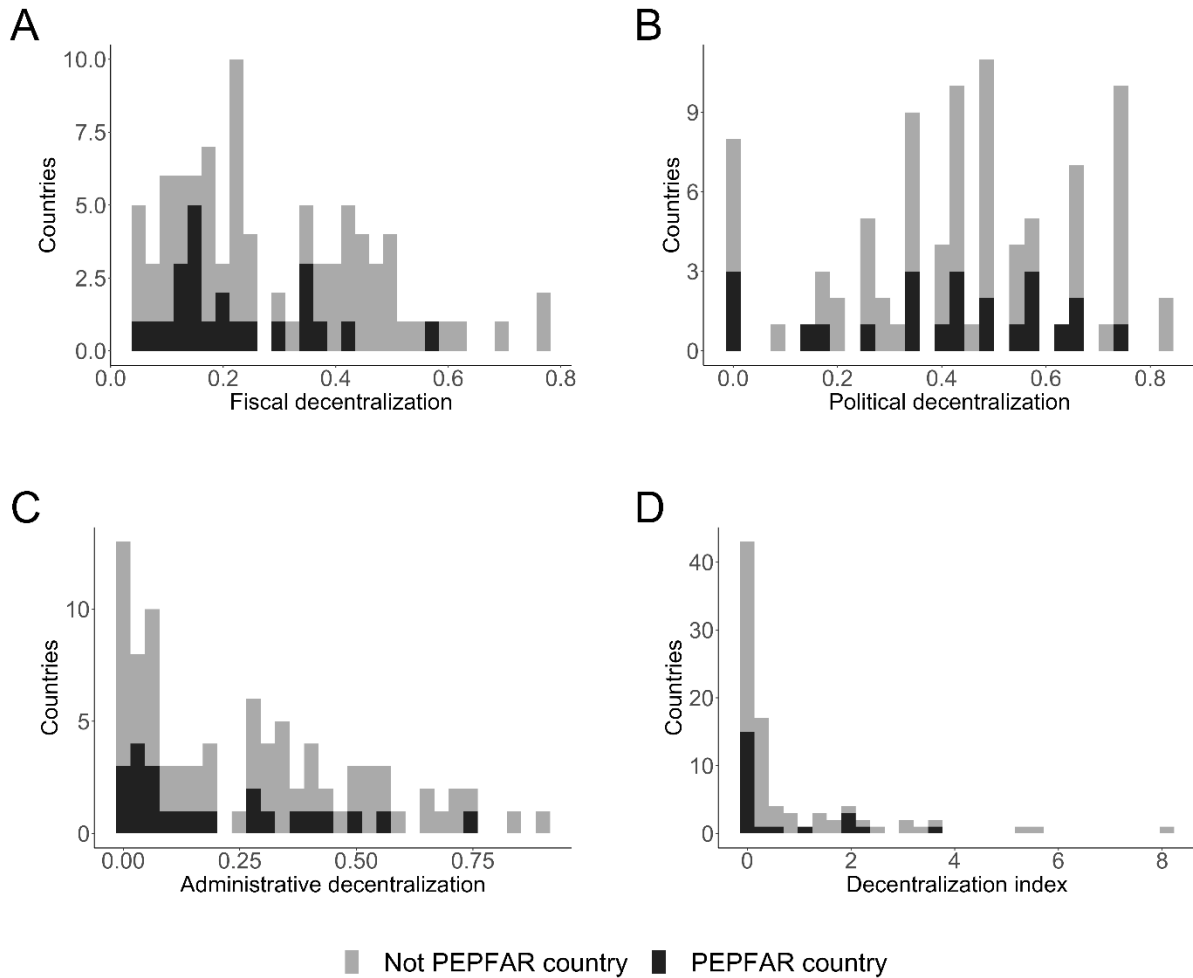
APPENDIX D: COUNTRY DISTRIBUTION ACROSS DEPENDENT VARIABLES FOR
2019 BY COUNTRY PEPFAR STATUS



Appendix D shows stacked bar charts of the number of countries by (A) reduction in HIV from 2010-2019, (B) percentage of people with HIV that know their status, (C) percentage of people with HIV who are on ART, and (D) percentage of people with HIV who have suppressed viral loads. The contribution to the bar from PEPFAR countries is shown by the black portion, with non-PEPFAR countries represented by the grey portion.

Appendix D.A represents the reduction in HIV from 2010-2019 across all LMICs included in the dataset. PEPFAR countries, which are represented by the black portion of the bars, experienced larger decreases in HIV incidence between 2010 and 2019 than non-PEPFAR countries. Across all three of the treatment cascade variables shown in Appendices B, C, and D, PEPFAR countries represent a larger proportion of the countries falling on the upper end of the percentages.

APPENDIX E: COUNTRY DISTRIBUTION ACROSS INDEPENDENT VARIABLES



Appendix E.A represents the distribution of countries across the primary independent variable of interest, fiscal decentralization. Appendices E.B and E.C represent the distribution of countries across the secondary independent variables of interest, political decentralization and administrative decentralization, respectively. The distribution of PEPFAR countries appears to mirror the distribution of non-PEPFAR countries, with slightly more non-PEPFAR countries being less fiscally decentralized than non-PEPFAR countries.

APPENDIX F: SUMMARY TABLE OF REGRESSION ESTIMATES

Outcome	PEPFAR vs. Non-PEPFAR	Fiscal decentralization	Political decentralization	Administrative decentralization
Reduction in HIV incidence	PEPFAR countries experienced significantly higher reductions in HIV incidence	PEPFAR countries with high degrees of fiscal decentralization experienced significant higher reductions in HIV incidence when compared to countries with the lowest degree of fiscal decentralization	LMIC with high degrees of political decentralization experienced significantly lower reductions in HIV incidence when compared to countries with the lowest degree of political decentralization	No stat sig results
% of HIV positive persons with known status	PEPFAR countries have a significantly higher % of HIV positive persons who know their HIV status	LMIC with mid-levels of fiscal decentralization have significantly more people who know their HIV status than countries with low fiscal decentralization	No stat sig results	No stat sig results
% of people living with HIV receiving ART	PEPFAR countries have a significantly higher % of people living with HIV receiving ART	LMIC with mid- and high degrees of fiscal decentralization have significantly more people living with HIV receiving ART than countries with low fiscal decentralization	PEPFAR countries with high degrees of political decentralization have significantly fewer people living with HIV on ART than countries with low political decentralization	No stat sig results
% of people living with HIV with VLS	PEPFAR countries have a significantly higher % of people living with HIV with VLS	No stat sig results	No stat sig results	No stat sig results