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Virtuous Feedback Loops among Foreign Direct Investment Flows, Institutional Quality, and Economic Growth: An Empirical Study on the Determinants of Sustainable Development

Abstract. *This study examines the relationship between foreign direct investment (FDI), institutional quality, economic growth, and sustainable development using a panel dataset of 91 countries from 2000 to 2022. It employs a hybrid panel-data modelling approach, integrating correlated random effects and quasi-demeaning methods to separate within- and between-country effects, mitigate endogeneity, and capture nonlinear dynamics in the FDI-growth-sustainability nexus. The results show that economic growth and institutional improvements are key channels through which FDI enhances sustainability, though excessive growth may harm long-run sustainability. The effects of FDI vary depending on the level of institutional development, indicating the context-dependencies of baseline findings. Although FDI generally fosters sustainability, its benefits diminish in advanced institutional settings. In weaker institutional environments, FDI flows and reforms reinforce each other, creating virtuous feedback loops. Robustness checks confirm these findings, underscoring the need for strategic FDI management and institutional reforms.*

Keywords: *sustainable development, FDI flows, institutional quality, economic growth.*

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1. Introduction

Achieving Sustainable Development Goals (SDGs) (United Nations, 2015) requires a profound grasp of the multifaceted factors affecting them, particularly given the disparities in the capacity of nations to mobilise resources and establish institutional frameworks that effectively drive development outcomes. This paper aims to contribute to the growing literature on sustainability by examining the interplay between foreign direct investments (FDIs), institutional factors, and economic growth in attaining the development objectives.

The analysis is structured around three core inquiries. First, how do FDI flows and institutional reforms individually and interactively influence progress toward

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sustainable development? Second, to what extent do these effects vary across countries with different levels of institutional quality? Third, how do these conditionalities and context-dependencies manifest themselves, and what do they reveal about the path to attaining sustainability objectives? We explore these questions leveraging a comprehensive panel dataset of 91 countries from 2000 to 2022.

Methodologically, the paper employs a hybrid panel-data modelling approach that allows us to distinguish within-country temporal variations from between-country cross-sectional effects while addressing any potential endogeneity bias stemming from unobserved heterogeneity among panels. By incorporating interaction terms into the baseline model, this study not only evaluates direct effects of the main relevant factors, but also uncovers context-dependent feedback loops among them that have been underexplored in the existing literature.

The empirical findings offer a nuanced perspective on the determinants of the SDG. First of all, FDI inflows and institutional improvements exert a favourable impact on sustainability outcomes. More particularly, FDI flows enhance SDG scores by unleashing the economic growth potential of the recipient countries given the institutional framework. However, an elevated economic growth rate alone harms sustainability in the long run, highlighting the potential downsides of unsustainable growth strategies excessively reliant on wage-suppressive export activities or extractive industries prevalent in developing countries. The evidence also suggests that demographic factors play a dual role. Population growth within countries positively influences SDG outcomes by enhancing human resource availability, whereas cross-country variations in population size reveal a negative association due to the challenges of scaling resources and infrastructure. Last but not least, a scrutiny of the interaction between FDI and institutions, however, points to the intricate feedback loops and synergies that emerge in different development contexts. In countries with weaker institutional frameworks, FDI amplifies the benefits of institutional reforms, suggesting a symbiotic relationship in which external investments and institutional improvements reinforce each other. Conversely, in countries with advanced institutional environments, diminishing returns to FDI emerge, potentially due to the saturation of initial gains and the shifting nature of cross-border investments toward activities with limited direct impact on sustainability metrics. These insights underscore the significance of tailoring capital openness, reforms, and growth policies to specific institutional development contexts to optimise their effectiveness. The key results survive after being subjected to various robustness checks and sensitivity analyses, which involve alternative sustainability and institutional quality metrics, and model specifications.

The rest of the paper is structured as follows: Section 2 presents the existing literature on the relationships between FDI, institutional quality, growth, and sustainable development; Section 3 describes the data and research methodology; Section 4 provides the estimation results; The conclusion is in the fifth section.

2. Literature review

- ***FDI and SDG Scores***

There are conflicting studies in the existing literature on how FDI impacts sustainable development. In a study by Martins et al. (2023), they examined the impact of FDI on sustainability in African sub-Saharan countries in terms of three pillars (environmental, social, and economic) and stated that FDI has no significant effect on these triple bottom line pillars. On the other hand, Aust et al. (2020) concluded that FDI has a positive impact on SDG scores in general, but a negative impact on SDG 13 (climate action). Izadi and Madirimov (2023) investigated the relationship between FDI and SDG scores using the data of 78 Eurasian counties for the period 2016-2018. They divided the dataset based on the income level of those countries and they arrived to the conclusion that encouraging foreign companies to invest in the economy will probably help all countries, regardless of income level, achieve the Sustainable Development Goals (SDGs). Since studies examining the relationship between FDI and the SDG score are quite limited, it is necessary to also examine studies investigating the effects of FDI on each aspect of sustainable development separately.

- ***FDI and the Environmental Pillar***

The existing literature shows that the overall impact of foreign direct investment on the environment is detrimental. Ahmed et al. (2022a) investigated the impact of industrialisation and FDI on environmental degradation in the Asia-Pacific region covering the period 1995-2020. Their findings demonstrated that foreign direct investment generally has a significant detrimental effect on the environment and it leads to a rise in methane and CO2 emissions. In another study conducted by Opoku and Boachie (2020), 36 African countries were examined with data covering the period 1980-2014 and it was revealed that FDI significantly negatively affected the environment since it increases CO_2 emissions and greenhouse gases. According to Huynh and Hoang (2019), who used panel data for 19 developing Asian countries between 2002 and 2015, FDI inflows initially increase air pollution in Asia. However, as institutional quality improves, this effect is lessened until it reaches a threshold, after which FDI reduces air pollution.

- ***FDI and the Economic Pillar***

In general, having FDI inflow to a country provides significant economic contributions to that country. One main possible contribution of FDI is poverty reduction. A study examining 6 Western Balkan countries with 2002-2021 period data shows that FDI makes a significant contribution to reducing poverty (Topalli et al., 2021). Woldetensaye et al. (2022) investigated the relation between FDI and unemployment in East African IGAD member countries and concluded that FDI has a significant negative effect on unemployment. A more recent study in Saudi Arabia by Alfalih (2024) also concluded that the FDI reduced the unemployment rate. Another main economic contribution is fostering the economic growth. For example,

in a study conducted by Pegkas (2015), the effect of FDI stock on economic growth in the Eurozone countries was examined and it was concluded that the effect was positive and significant.

Considering that sustainable development goals start with the goals of eliminating poverty and hunger, FDI should have a positive impact on the SDG score in this sense.

- ***FDI and Social Pillar***

One of the 17 goals of sustainable development is the reduction of social and economic inequality. At this point, it is possible to say that FDI produces contradictory results. According to the results of a study conducted by Xu et al. (2021) with 2000-2015 data from 38 sub-Saharan African countries, FDI has a reducing effect on income inequality. In another study conducted by Le et al. (2021) in Vietnam shows that FDI tends to exacerbate income inequality in Vietnam; however, the negative impact of FDI on income inequality can be moderated by institutional improvements and higher educational attainments.

Another of the 17 goals of the United Nations is to achieve gender equality and empower all women and girls. Many studies show that FDI has an impact on empowering women and eliminating gender inequality. An IMF working paper, using a panel dataset including 94 developing nations between 1990 and 2015, conducted by Ouedraogo and Marlet (2018) demonstrates that foreign direct investment inflows have a negative correlation with gender inequality and a positive correlation with gender development. Ouedraogo and Marlet (2018) state that FDI inflows contribute to the improvement of women's welfare and reducing gender inequalities, primarily in the areas of health and education. In a more recent study, Irandoust (2024) examined the impact of FDI on women's labour force participation in 14 Arab countries. The research was conducted with data from 1991 to 2021 and it was found that FDI inflows increased women's participation in the workforce in almost half of the sample countries. Irandoust (2024) came to the conclusion that FDI inflows contribute to improving women's well-being and decreasing gender disparities.

Ensuring healthy lives and promoting well-being for all at all ages is another goal of sustainable development. Using data from 1980 to 2018 across 43 African nations, Immurana (2021) examined the impact of FDI on health indicators such as life expectancy and mortality rates by applying the panel fixed effects estimator. The research concludes that FDI positively influences health outcomes. Also, Chiappini et al. (2022) examined the relationship between FDI and population health using data from 143 countries between 1990 and 2019. They discovered an overall positive correlation between FDI and health. However, the study results also showed that this positive correlation decreases as a country's GDP per capita increases. This suggests that more developed economies benefit less from inward FDI, while developing economies benefit greatly. The effect is negative for the most developed countries in the sample. Another study by Immurana et al. (2023) using data from 39 African countries from 1980 to 2018 found that FDI improved child health outcomes.

Although some studies reveal negative environmental effects of FDI (Opoku and Boachie, 2020), the overall impact seems to be positive since it decreases the unemployment rate (Alfalih, 2024), reduces poverty (Topalli et al., 2021), fosters economic growth (Pegkas, 2015), reduces gender inequality (Ouedraogo and Marlet, 2018) and improves health outcomes (Immurana, 2021).

- ***Institutional Quality and SDG Scores***

When institutional quality and sustainable development studies are examined, it can be seen in the literature that institutional quality has positive effects on sustainable development. There are studies showing that institutional quality has positive effects, especially on environmental sustainability. For example, Addai et al. (2024) examined the impact of renewable energy and institutional quality on ecological footprint using the data of N-11 countries from 1990 to 2022. The study results reveal that institutional quality has a negative and significant impact on the ecological footprint. In another study focusing on South Asian countries and examining the period 2000-2018, Ahmed et al. (2022b) found that financial development and institutional quality had a positive effect on green economic growth in the long run.

According to a study conducted by Kouadio and Gakpa (2022) and investigating West Africa for the period 1984-2015, economic growth is still an important condition for lowering poverty, and long-term reductions in poverty and income inequality are greatly aided by general improvements in institutional quality. According to the study finding, a general improvement in the institutional environment will help reduce poverty by increasing per capita household spending. The results also demonstrate that a decrease in income inequality is linked to the presence of democratic institutions, the easing of bureaucratic restrictions, the management of corruption, the stability of the government, and the enhancement of the institutional environment as a whole.

In addition, it is possible to say that institutional quality has an impact on the quality of education, that is, on the fourth goal of sustainable development. Fomba et al. (2023) tried to find a relationship between institutional quality and educational quality using the data of 82 developing countries. They found that school completion and student achievement are positively impacted by institutional quality, but educational failure is negatively impacted.

- ***Economic Growth and SDG Scores***

Since sustainable development has goals covering a wide range of areas, the impact of economic growth on SDG scores varies in the literature.

Economic growth can have negative effects on the environmental pillar of sustainability. For example, in previous studies Addai et al. (2024) found a positive association between economic growth and ecological footprint. Anwar et al. (2020) discovered a positive relationship between economic growth and CO_2 emissions in their study examining the period 1980-2017 of Far East Asian countries.

However, economic growth can positively influence the economic pillar of sustainability. A study examining the period 1991-2019 in Jordan showed that economic growth negatively affected unemployment (Hjazeen et al. 2021). Additionally, economic growth can contribute to poverty reduction (Fanta and Upadhyay, 2009). Despite some positive effects of economic growth, its overall impact is expected to be negative, especially since its impact on the environment is negative.

3. Data and Methodology

3.1 Data

Due to the availability of the data, this study covers the years from 2000 to 2022. SDG scores of 91 countries were obtained from the website of sdgindex.org and it was based on the work of Sachs et al. (2023).

Our metric of sustainability is the countries' sustainable development goals (SDGs) score which measures their overall performance in achieving all 17 SDGs. Since individual scores on all these goals are highly interrelated, we carry out the principal component analysis (PCA) on the covariance matrix of the 17 SDG scores to construct a data-driven composite sustainability index. The PCA methodology enables us to extract the most relevant information from all 17 individual goals scores while applying the dimensionality reduction in the least possible harmless way. Since all SDG scores are ranged from 0 to 100, and hence in commensurable unit of measurements, we perform the PCA on the covariance matrix of all 17 SDGs scores whose eigenvalues obtained from the spectral decomposition are arranged in a descending order. The composite SDG index constructed by using the eigenvalues of the covariance matrix for the linear combination of individual SDG scores will provide us with another SDG measurement and will be used for robustness check purposes.

A country's institutional development is another critical factor in its SDG score. We measure it by two proxy variables, the freedom index and institutional quality index. The freedom index was obtained from Freedom House. The index has two components: political rights and civil liberties. These two components take values from 1 to 7 for each component, with 1 meaning the highest degree of freedom. Thus, the country with the least freedom in total gets the value 14, and the country with the highest freedom gets the value 2.

The World Bank, World Governance Indicators (WGI) database, compiles estimates about six institutional quality indicators such as control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and voice and accountability. Since these indicators are highly correlated and we do not have any particular preference for one aspect of institutional quality over another, we construct an overall institutional quality index through the PCA outlined above.

Since the correlation between these two measures is high (-0.78), we keep only one of them in the respective models. Since the institutional quality index takes advantage of more institutional indicators than the freedom index, we prefer to use the former index more often in the model specifications below. The highest correlation among variables is between the two institutional quality indexes with -0.78, indicating that there is no severe multicollinearity.

Other data containing foreign direct investment, GDP growth, population, domestic health expenditure, and military expenditure were obtained from the World Bank (2024). All variables and descriptive statistics are given in Table 1. In Table 1, lnfdi is natural logarithm of net inflows (BoP, current US$), gdpgrowth is annual GDP growth (%), lnpop is the natural logarithm of total population, govcons is final consumption expenditure (% of GDP), domhealthexp is domestic general government health expenditure (% of general government expenditure), milexp is military expenditure (% of general government expenditure).

Table 1. Variables and Descriptive Statistics

Variables	Notation	Obs.	Mean	Std Dev.	Min	Max
Dependent Variables						
SDG Score	sdgscore	3749	64.18	10.70	36.0	86.8
SDG Score (pca)	sdg-pca	2438	166.16	63.29	41.21	286.12
Independent Variables						
Foreign Direct Investment	lnfdi	3447	20.86	2.37	10.36	27.32
Institutional Quality (pca)	insqual	3580	-0.20	2.22	-5.85	4.79
GDP Growth	gdpgrowth	3699	3.69	4.88	-36.66	63.37
Population	lnpop	3749	16.09	1.68	11.88	21.07
Government Cosumption	govcons	3390	79.10	15.94	12.17	140.81
Domestic Health Expenditure	domhealthep	3381	9.97	4.67	0.73	33.10
Military Expenditure	milexp	3146	7.06	5.83	0.22	43.16
Freedom Index	freeindex	3737	6.97	3.90	2	14

Source: Authors' own processing.

3.2 Methodology

We run panel-data hybrid and correlated random-effects models to identify the channels through which FDIs, institutional quality, and economic growth work out their impact on sustainability outcomes. The flexibility of these models enables us to differentiate the effects of independent variables' within-country variations over time from the effects of their across-country variations. The ease and convenience with which these models accommodate interactive terms also help us analyse the feedback loops among independent variables. Our baseline model is given by

$$y_{it} = \alpha + \boldsymbol{X_{it}\beta} + \mu_i + \varepsilon_{it}, \qquad i = 1,2,\dots,n, \qquad and\ t = 1,2,\dots,T_i \tag{1}$$

where μ_i and ε_{it} represent the time-invariant unobservable factors and the idiosyncratic error term follows a white noise process (that is, $E[\varepsilon_{it}] = 0$, $cov(\varepsilon_{it}, \varepsilon_{is}) = 0 \; for \; t \neq s$), respectively. While y_{it} represents the SDG score, $\boldsymbol{X_{it}}$ is a row vector of independent variables. The subscripts i and the t denote the country and year, respectively. Let's introduce the Mundlak's assumption (1978):

$$\mu_i = \bar{\boldsymbol{x}}_{\boldsymbol{i}}\boldsymbol{\varphi} + u_i \; where \; E(u_i|X_{it}) = 0 \tag{2}$$

where $\bar{\boldsymbol{x}}_{\boldsymbol{i}} = \frac{\sum_{t=1}^{T_i} \boldsymbol{X_{it}}}{T_i} \; for \; all \; i = 1, \dots, N$ represents the panel averages of any explanatory variables in the model. By the zero conditional mean assumption, we could decompose the error component μ_i so that u_i captures all time-invariant unobservable factors that are uncorrelated with any functions of independent variables. By plugging (2) into (1) and some simple algebra, we get the following equations

$$y_{it} = \alpha + \boldsymbol{X_{it}}\boldsymbol{\beta} + \bar{\boldsymbol{x}}_{\boldsymbol{i}}\boldsymbol{\varphi} + u_i + \varepsilon_{it} \tag{3}$$

$$y_{it} = \alpha + (\boldsymbol{X_{it}} - \bar{\boldsymbol{x}}_{\boldsymbol{i}})\boldsymbol{\beta} + \bar{\boldsymbol{x}}_{\boldsymbol{i}}(\boldsymbol{\varphi} + \boldsymbol{\beta}) + u_i + \varepsilon_{it} \tag{4}$$

where $\boldsymbol{\beta}$ is a column vector of within-effects, and $\boldsymbol{\varphi} + \boldsymbol{\beta}$ is a column vector of between effects. The equation 3 and 4 are known as the correlated random-effects model and the hybrid model, respectively (Wooldridge, 2010). To estimate these models, we rely on the quasi-demeaning method, which gives us the Mundlak regression:

$$\begin{aligned} y_{it} - \theta_i\bar{y}_i = {} & (1-\theta_i)\alpha + (\boldsymbol{X_{it}} - \boldsymbol{\theta_i}\bar{\boldsymbol{x}}_{\boldsymbol{i}})\boldsymbol{\beta} + (1-\theta_i)\bar{\boldsymbol{x}}_{\boldsymbol{i}}\boldsymbol{\varphi} \\ & + \{(1-\theta_i)u_i + (\varepsilon_{it} - \theta_i\bar{\boldsymbol{\varepsilon}}_{\boldsymbol{i}})\} \end{aligned} \tag{5}$$

where $\theta_i = 1 - \sqrt[2]{\frac{\sigma_\varepsilon^2}{T_i\sigma_u^2 + \sigma_\varepsilon^2}}$. The estimation of the transformed model (6) by the ordinary least square (OLS) gives the random-effects generalised least squares (GLS) estimator. The estimation of the parameter θ_i is a bit subtle. The within-residuals and residuals from the between model are used to estimate the idiosyncratic error component σ_ε^2, and the individual component σ_u^2, respectively.

To analyse the conditional impact of one independent variable on dependent variable through another independent variable, we add interaction terms for the model (3) and (4) as follows:

$$\begin{aligned} y_{it} = {} & \alpha + \beta_1(X_{1it} - \bar{x}_{1i}) + \beta_2\bar{x}_{1i} + \beta_3(X_{2it} - \bar{x}_{2i}) + \beta_4\bar{x}_{2i} \\ & + \beta_5(X_{1it}X_{2it} - \overline{x_{1i}x_{2i}}) + \beta_6\,\overline{x_{1i}x_{2i}} + (\boldsymbol{Z_{it}} - \bar{\boldsymbol{z}}_{\boldsymbol{i}})\boldsymbol{\phi_1} + \bar{\boldsymbol{z}}_{\boldsymbol{i}}\boldsymbol{\phi_1} \\ & + u_i + \varepsilon_{it} \end{aligned} \tag{6}$$

where the independent variables matrix X is partitioned as $X = [X_{1it} \quad X_{2it} \quad \boldsymbol{Z_{it}}]$. The average partial effect of X_{1it} (APE) is calculated by taking the partial derivative of $E[y_{it}|\, X_{it}]$

$$\frac{\partial E[y_{it}|\, X_{it}]}{\partial X_{1it}} = \beta_1 + \beta_5 X_{2it}$$

and averaging across the population distribution of X_{2it}

$$E_{X_{2it}}[\beta_1 + \beta_5 X_{2it}] = \beta_1 + \beta_5 E(X_{2it}) .$$

A natural and consistent estimator for the APE is given by

$$\left\{\frac{\partial \hat{y}}{\partial X_{1it}}\right\}_{X_{2it}=\bar{\bar{X}}_2} = \beta_1 + \beta_5 \bar{\bar{X}}_2$$

where $\bar{\bar{X}}_2 = \sum_{i=1}^{n}\sum_{t=1}^{T_i} X_{2it}/(nT_i)$, and $\hat{y}$ represents the predicted values of y in (6) by the random effects GLS estimator.

4. Estimation

4.1 Main Results

The baseline hybrid model estimates are given in Table 2.

Table 2. Baseline Estimate Results

Dependent Variables	sdg-pca	sdgscore	sdg-pca	sdgscore	sdg-pca	sdgscore
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
lnfdi (within)	1.85***	0.39***	1.60***	0.35***	1.61***	0.36***
	(0.46)	(0.11)	(0.43)	(0.10)	(0.44)	(0.10)
lnfdi (between)	22.11***	2.96***	14.38***	1.79***	13.09***	1.50**
	(2.70)	(0.55)	(3.08)	(0.58)	(3.38)	(0.66)
lnfdi×gdpgrowth (within)					-0.00	-0.00
					(0.04)	(0.01)
lnfdi×gdpgrowth (between)					0.44*	0.10*
					(0.26)	(0.06)
insqual (within)			5.97***	1.08***	5.98***	1.08***
			(1.36)	(0.30)	(1.38)	(0.31)
insqual (between)			13.79***	2.17***	14.00***	2.21***
			(2.29)	(0.45)	(2.28)	(0.45)
gdpgrowth (within)	-0.49***	-0.12***	-0.45***	-0.11***	-0.35	-0.06
	(0.10)	(0.02)	(0.08)	(0.02)	(0.80)	(0.16)
gdpgrowth (between)	-3.68	-0.44	-3.60**	-0.45	-11.93**	-2.30*
	(2.35)	(0.40)	(1.82)	(0.33)	(5.62)	(1.18)
lnpop (within)	53.26***	12.08***	57.48***	12.80***	57.49***	12.81***
	(9.67)	(2.14)	(9.67)	(2.12)	(9.71)	(2.13)
lnpop (between)	-14.10***	-1.71***	-7.27***	-0.70	-7.23***	-0.69
	(2.46)	(0.49)	(2.68)	(0.54)	(2.73)	(0.54)
govcons (within)	-0.11	-0.03				
	(0.13)	(0.03)				
govcons (between)	-0.21	-0.02				
	(0.33)	(0.06)				
domhealthexp (within)	1.25***	0.28***	1.21***	0.27***	1.20***	0.27***
	(0.27)	(0.06)	(0.27)	(0.06)	(0.27)	(0.06)

Dependent Variables	sdg-pca	sdgscore	sdg-pca	sdgscore	sdg-pca	sdgscore
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
domhealthexp (between)	2.32**	0.46**	1.55*	0.36**	1.63**	0.38**
	(1.00)	(0.19)	(0.81)	(0.16)	(0.82)	(0.16)
milexp (within)	-0.46**	-0.10**	-0.39*	-0.09**	-0.39*	-0.09**
	(0.22)	(0.05)	(0.22)	(0.04)	(0.22)	(0.04)
milexp (between)	0.69	-0.02	0.77	-0.05	1.18**	0.04
	(0.85)	(0.16)	(0.61)	(0.15)	(0.56)	(0.14)
freeindex (within)	0.03	-0.02				
	(0.56)	(0.12)				
freeindex (between)	-3.78***	-0.71***				
	(1.33)	(0.26)				
cons	-49.89	33.50***	-30.79	36.82***	-12.04	40.95***
	(65.87)	(11.63)	(34.54)	(6.46)	(40.19)	(8.00)
R Squared overall	0.785	0.688	0.822	0.715	0.832	0.732
N. of obs.	1,633	1,633	1,633	1,633	1,633	1,633
N. of groups	91	91	91	91	91	91

The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Values below the coefficient estimates in parentheses are robust standard errors.

Source: Authors' own processing.

The models 1-4 reveal that FDI flows and improvements in institutional framework have positively significant within- and between-effect on both measures of SDG. While increases in foreign investments and affirmative reforms increase the SDG score over time for a typical country, a higher level of FDI flows and institutional quality tends to be associated with better SDG scores across countries. Having a robust institutional infrastructure and being a favourable destination for foreign investments enhance sustainability outcomes over time and across countries.

The negative within effect of economic growth underlines a trade-off between economic growth and sustainability, while its between-effect proves insignificant in all specifications except at model 3. When a country manages to achieve a growth rate above its historical average, its sustainability metrics tend to decrease as a result of possible degradation in environmental quality such as increased pollution, resource exhaustion, or possible deterioration in social welfare like a more skewed income distribution, elevated poverty rates.

A variation on the standard specification with the inclusion of interaction between FDI flows and economic growth sheds further light on the transmission mechanisms (the models 5-6). The significantly positive between-effect of the interaction term emphasises the complementarity between foreign investments and growth. More precisely, the growth-enhancing effects of FDI flows generate a virtuous feedback loop on sustainability outcomes when they both stay elevated in the long run. Their insignificant within-effect coefficient suggests that within-country fluctuations in growth and FDI flows do not result in a combined effect on the SDG scores over time. Last but not least, the negative between-effect of growth becomes more pronounced and gains significance at the 5% level. The adverse

impact of cross-country variations in growth on the SDG score may imply that high growth rates, typically a feature of developing countries, might have possibly attained by excessive reliance on export-driven manufacturing activities or extractive industries, which may not necessarily translate into better sustainability scores on education, health, social equality, and environmental quality.

Demographical dynamics have varying impact on sustainability as seen by the opposite signs before its within- and between-effects. An increase in population over time may provide additional human resources beneficial to sustainable development, as suggested by the positive within-effects. On the other hand, the negative between-effect implies that more populous countries tend to have lower SDG scores, since it would require more resources and public infrastructure to provide high-quality education and health services for a larger population, thereby potentially straining a country's ability to meet development goals in an effective manner. A study on resource-rich sub-Saharan African countries shows that population density decreases environmental sustainability (Erdogan, 2024).

The sign and significance of military spending, domestic health expenditures, and freedom index prove to be consistent with the main body of related literature. The negative impact of military spending on the SDG is attributed to the damage inflicted on the environment through enhanced levels of carbon dioxide emissions (Isiksal, 2021). Spending on health improves health outcomes by decreasing infant and child mortality (Farag et al., 2013). Aust et al. (2020) show that political and civil rights make a positive impact on SDG scores. We may regard these results as a sign of correct model specification.

We now turn to the examination of complex relationships among FDI flows, institutional quality, and sustainability. More particularly, we scrutinise whether institutional reforms and FDI flows could create a positive feedback loop on each other. To this end, we divide the sample data according to the various levels of institutional quality index and examine its joint behaviour with FDI flows and SDG scores.

Table 3. The Impact of FDI on SDG in Poor Institutional Environment

Dependent variables	**sdg-pca**	**sdgscore**	**sdg-pca**	**sdgscore**
Institutional quality threshold	**insqual< -1**	**insqual< -1**	**insqual < 0**	**insqual < 0**
Independent variables	**(1)**	**(2)**	**(3)**	**(4)**
lnfdi (within)	4.156**	0.894***	2.878***	0.566***
	(1.958)	(0.308)	(0.927)	(0.185)
lnfdi (between)	18.946***	2.748***	18.648***	2.846***
	(5.391)	(0.940)	(4.741)	(0.852)
lnfdi×insqual (within)	1.645**	0.344***	1.110**	0.199**
	(0.829)	(0.126)	(0.483)	(0.089)
lnfdi×insqual (between)	1.951	0.342	0.926	0.158
	(2.197)	(0.392)	(1.973)	(0.370)
insqual (within)	-28.439*	-5.858**	-15.780*	-2.613
	(16.548)	(2.575)	(9.435)	(1.742)

Dependent variables	sdg-pca	sdgscore	sdg-pca	sdgscore
Institutional quality threshold	insqual< -1	insqual< -1	insqual < 0	insqual < 0
Independent variables	(1)	(2)	(3)	(4)
insqual (between)	-15.166	-1.619	-0.880	0.678
	(47.170)	(8.380)	(42.054)	(7.839)
gdpgrowth (within)	-0.262**	-0.061**	-0.374***	-0.083***
	(0.127)	(0.025)	(0.109)	(0.022)
gdpgrowth (between)	-5.234**	-0.713	-4.448**	-0.581
	(2.466)	(0.435)	(2.258)	(0.398)
lnpop (within)	70.553***	15.334***	72.015***	15.651***
	(4.831)	(1.079)	(7.209)	(1.638)
lnpop (between)	-4.525	-0.462	-7.548*	-1.173
	(4.122)	(0.728)	(4.402)	(0.824)
domhealthexp (within)	0.959***	0.202***	1.226***	0.256***
	(0.201)	(0.042)	(0.270)	(0.058)
domhealthexp (between)	1.690	0.269	2.198**	0.382**
	(1.174)	(0.207)	(1.061)	(0.194)
milexp (within)	-0.093	-0.025	-0.234	-0.051
	(0.224)	(0.040)	(0.224)	(0.040)
milexp (between)	1.634*	0.265	1.226	0.188
	(0.863)	(0.162)	(0.850)	(0.164)
cons	-156.293**	17.090	-115.626*	23.470**
	(74.236)	(13.105)	(59.825)	(11.080)
R Squared overall	0.701	0.638	0.689	0.640
N. of obs.	511	511	880	880
N. of groups	45	45	54	54

The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Values below the coefficient estimates in parentheses are robust standard errors.

Source: Authors' own processing.

For a typical country with poor institutional quality (as proxied by institutional quality index values below 0 and -1), the impact of institutional reforms is positively conditional on FDI flows. Specifically, direct investments could amplify the effectiveness of improvements in institutional quality beyond its own individual favourable impact on sustainability outcomes, as suggested by the significantly positive coefficient before the within-effect of the interaction term (Table 3). This finding might point to the possibility of mutual symbiosis in which FDI flows require a more stable institutional environment, and reforms strengthen the positive effects of external know-how, cutting-edge technologies, and management practices brought about by FDI inflows. It follows that increasing returns could apply to FDI flows with the introduction of reforms in the context of countries with backward institutions. It may seem at first glance that better institutions over time may worsen the SDG score as indicated by the significantly negative within effect coefficient, its average partial effect, however, is still considerably positive (for example, in model 2, it is calculated as 1.3= -5.86 +0.34[20.86]).

Table 4. The Impact of FDI on SDG in Advanced Institutional Environment

Dependent variables	sdg-pca	sdgscore	sdg-pca	Sdgscore
Institutional quality threshold	insqual > 1	insqual > 1	insqual > 0	insqual > 0
Independent variables	(1)	(2)	(3)	(4)
lnfdi (within)	3.975***	0.877**	3.698***	0.715**
	(1.339)	(0.351)	(1.083)	(0.282)
lnfdi (between)	4.305	-0.411	12.711***	1.181
	(3.590)	(0.968)	(4.463)	(0.953)
lnfdi×insqual (within)	-1.186***	-0.244**	-1.113***	-0.194**
	(0.407)	(0.102)	(0.334)	(0.084)
lnfdi×insqual (between)	-0.012	0.036	-1.681	-0.300
	(1.166)	(0.272)	(1.298)	(0.280)
insqual (within)	27.046**	4.856*	26.900***	4.169**
	(10.717)	(2.745)	(8.421)	(2.038)
insqual (between)	20.017	1.959	54.154*	9.093
	(27.184)	(6.243)	(29.165)	(6.302)
gdpgrowth (within)	-0.308***	-0.086***	-0.446***	-0.117***
	(0.104)	(0.024)	(0.115)	(0.026)
gdpgrowth (between)	-3.126	-0.403	-6.116***	-0.887**
	(1.956)	(0.468)	(1.795)	(0.375)
lnpop (within)	-3.614	1.931	18.390	5.580
	(8.051)	(2.174)	(16.729)	(3.907)
lnpop (between)	1.164	1.067	-7.406**	-0.554
	(2.586)	(0.768)	(3.419)	(0.746)
domhealthexp (within)	2.762***	0.674***	1.316*	0.341**
	(0.522)	(0.123)	(0.682)	(0.159)
domhealthexp (between)	-1.638	-0.126	0.493	0.270
	(1.674)	(0.360)	(1.345)	(0.275)
milexp (within)	-1.611***	-0.280**	-1.407**	-0.292**
	(0.570)	(0.128)	(0.595)	(0.141)
milexp (between)	-0.072	-0.404*	1.290*	-0.018
	(0.815)	(0.222)	(0.709)	(0.223)
cons	92.721	64.639***	22.835	50.117***
	(71.267)	(17.712)	(63.221)	(13.803)
R Squared overall	0.701	0.538	0.734	0.526
N. of obs.	569	569	753	753
N. of groups	36	36	48	48

The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Values below the coefficient estimates in parentheses are robust standard errors.

Source: Authors' own processing.

Table 4 yields interesting results. When a typical country with well-established institutions experiences a simultaneous increase in both FDI flows and institutional quality index over time, their combined effect may not result in any further SDG score gains beyond their individual contributions. Here we witness a story of diminishing returns to FDI flows at higher levels of institutional quality. When a country already has robust institutions in place, a higher level of FDI flows in the capital markets may yield unsatisfactory results on sustainability outcomes, since the potential gains from foreign investments may have long been materialised by then. This puzzling finding might be attributed to the changing nature of FDI activities in high institutional quality environments. Recent trends indicate that cross-border investment flows among advanced countries have consisted more and more of merger and acquisition activities, which may not directly contribute to sustainability metrics (UNCTAD, 2024). Therefore, diminishing returns may accrue to FDI flows because of a possible mutation in the nature of these flows at higher levels of institutional quality.

4.2 Robustness Checks and Sensitivity Analyses

The robustness of the findings was verified using alternative sustainability measurements such as the overall SDG score and its PCA version (Table 2-4). The results remained consistent with these variations, confirming the reliability of the estimated relationships. Furthermore, the nonlinear effects of institutional quality and FDI survive the sensitivity analyses, which use different thresholds of overall institutional quality index as proxy for institutional development level when dividing the sample for countries with advanced and poor institutions (Table 3-4).

Additionally, all the coefficients of interest preserve their sign and significance when we add time dummies to account for unobservable time-varying, country-invariant factors. These adjustments ensured that the conclusions were not driven by omitted variable bias or temporal trends, strengthening the validity of the results. Although not presented in the main manuscript for brevity, these additional checks are available upon request.

The fact that the sign and significance of a set of control variables, such as demographic trends, military spending, domestic health expenditures, and freedom index, is consistent with the rest of the related literature indicates that the baseline regression models may not be subject to severe misspecification problems.

5. Conclusions

This study provides a comprehensive empirical analysis of the interplay between foreign direct investments, institutional quality, and economic growth in achieving the United Nations' Sustainable Development Goals. Methodologically, it leverages advanced panel data models to distinguish within-country and between-country effects, while also uncovering nonlinearities and feedback loops between key variables. These methodological advancements offer new perspectives on sustainability determinants.

The findings emphasise the positive role of FDI and institutional quality in improving the SDG scores over time and across countries. Economic growth stands

out as one of the main channels through which the FDI improves sustainability outcomes, while growth per se presents significant trade-offs, particularly through its negative between-effect on SDG scores possibly due to environmental and social costs. FDI amplifies the benefits of institutional reforms in countries with weaker frameworks, creating a virtuous feedback loop among them. However, diminishing returns to FDI emerge in countries with advanced institutional environments, signalling the potential saturation of initial gains and shifts in the nature of investments.

Despite its contributions, this study has certain limitations. It does not differentiate the effects of various types of FDI (for instance, manufacturing, agriculture, or finance) or consider the origin of FDI due to data constraints. Additionally, while the analysis focuses on aggregate measures, future research could explore more granular impacts, such as sector-specific FDI effects or regional disparities in sustainability outcomes.

Further research should also investigate the long-term dynamics of the identified feedback loops and nonlinearities. Expanding the analysis to include other sustainability dimensions or alternative institutional quality measures could provide a better understanding of the mechanisms driving SDG achievements. Addressing these limitations will enhance the robustness and applicability of the findings to diverse policy contexts.

The study's insights underscore the importance of tailored strategies that optimise the interplay of FDI and institutional reforms, while carefully managing economic growth's trade-offs, to maximise progress toward the SDGs.

References

[1] Addai G., Amegavi G.B., Robinson G. (2024), *Advancing environmental sustainability: The dynamic relationship between renewable energy, institutional quality, and ecological footprint in the N-11 countries. Sustainable Development*, https://doi.org/10.1002/sd.3096.

[2] Ahmed, F., Ali, I., Kousar, S., Ahmed S. (2022a), *The environmental impact of industrialization and foreign direct investment: empirical evidence from Asia-Pacific region. Environmental Science and Pollution Research* 29, 29778-29792, https://doi.org/10.1007/s11356-021-17560-w.

[3] Ahmed, F., Kousar, S., Pervaiz, A., Shabbir, A. (2022b), *Do institutional quality and financial development affect sustainable economic growth? Evidence from South Asian countries. Borsa Istanbul Review*, 22(1), 189-196, https://doi.org/10.1016/j.bir.2021.03.005.

[4] Alfalih, A.A. (2024), *The impact of oil prices, foreign direct investment and trade openness on unemployment rates in an oil-exporting country: The case of Saudi Arabia. Heliyon*, 10(3), 1-15, https://doi.org/10.1016/j.heliyon.2024.e25094.

[5] Anwar, A., Younis, M., Ullah, I. (2020), *Impact of urbanization and economic growth on CO2 emission: a case of far east Asian countries. International Journal of Environmental Research and Public Health*, 17(7), 2531, doi: 10.3390/ijerph17072531.

[6] Atilaw Woldetensaye, W., Sisay Sirah, E., Shiferaw, A. (2022), *Foreign direct investments nexus unemployment in East African IGAD member countries a panel data approach. Cogent Economics & Finance*, 10(1), https://doi.org/10.1080/23322039.2022.2146630.

[7] Aust, V., Morais, A.I., Pinto, I. (2020), *How does foreign direct investment contribute to Sustainable Development Goals? Evidence from African countries. Journal of Cleaner Production*, 245, 118823.

[8] Chiappini R., Coupaud M., Viaud F. (2022), *Does attracting FDI affect population health? New evidence from a multi-dimensional measure of health. Social Science & Medicine*, 301, 114878.

[9] Erdogan, S. (2024), *Linking natural resources and environmental sustainability: a panel data approach based on the load capacity curve hypothesis. Sustainable Development*, 32(4), 3182-3194, https://doi.org/10.1002/sd.2836.

[10] Fanta, F., Upadhyay, M.P. (2009), *Poverty Reduction, Economic Growth and Inequality in Africa. Applied Economics Letters*, 16 (18), 1791-1794.

[11] Farag M., Nandakumar A.K., Wallack S., Hodgkin D., Gaumer G., Erbil C. (2013), *Health expenditures, health outcomes and the role of good governance. International Journal of Health Care Finance and Economics*, 13, 33-52, https://doi.org/10.1007/s10754-012-9120-3.

[12] Fomba, B.K., Talla, D.N.D.F., Ningaye, P. (2023), *Institutional quality and education quality in developing countries: Effects and transmission channels. Journal of the Knowledge Economy*, 14, 86-115, https://doi.org/10.1007/s13132-021-00869-9.

[13] Freedom House (2024), https://freedomhouse.org/report/freedom-world (Accessed 28 April 2024).

[14] Hjazeen, H., Seraj, M., Ozdeser, H. (2021), *The nexus between the economic growth and unemployment in Jordan. Future Business Journal*, 7, 42, https://doi.org/10.1186/s43093-021-00088-3.

[15] Huynh C.M., Hoang H.H. (2019), *Foreign direct investment and air pollution in Asian countries: does institutional quality matter? Applied Economics Letters*, 26(17), 1388-1392, https://doi.org/10.1080/13504851.2018.1563668.

[16] Immurana M. (2021), *How does FDI influence health outcomes in Africa? African Journal of Science, Technology, Innovation and Development*, 13(5), 583-593, https://doi.org/10.1080/20421338.2020.1772952.

[17] Immurana M., Iddrisu A.A., Owusu S., Yusif H.M. (2023), *Foreign direct investment and child health outcomes in Africa. Cogent Economics & Finance*, 11(1), 2164565, https://doi.org/10.1080/23322039.2022.2164565.

[18] Irandoust, M. (2024), *Does FDI encourage female labor force participation? Evidence from Arab countries. Business Economics* 59, 174–189, https://doi.org/10.1057/s11369-024-00365-3.

[19] Isiksal, A.Z. (2021), *Testing the Effect of Sustainable Energy and Military Expenses on Environmental Degradation: Evidence from the States with the Highest Military Expenses. Environmental Science and Pollution Research*, 28, 20487-20498, https://doi.org/10.1007/s11356-020-11735-7.

[20] Izadi, J., Madirimov B. (2023), *Effect of foreign direct investment on sustainable development goals? Evidence from Eurasian countries, Journal of Sustainable Finance & Investment*, doi: 10.1080/20430795.2022.2163846.

[21] Kouadio, H.K., Gakpa, L.L. (2022), *Do economic growth and institutional quality reduce poverty and inequality in West Africa? Journal of Policy Modeling*, 44(1), 41-63.

[22] Le, Q.H., Do, Q.A., Pham, H.C., Nguyen, T.D. (2021), *The impact of foreign direct investment on income inequality in Vietnam. Economies*, 9(1), 1-15, https://doi.org/10.3390/economies9010027.

[23] Martins, R.V., Santos, E., Eugénio, T., Morais, A. (2023), *Is foreign direct investment caring for sustainability? A look in African sub-Saharan countries, Sustainability Accounting, Management and Policy Journal*, 14(5), 978-1001, doi:10.1108/SAMPJ-01-2022-0046.

[24] Mundlak, Y. (1978), *On the pooling of time series and cross section data. Econometrica: Journal of the Econometric Society*, 46(1), 69-85.

[25] Opoku E.E.O., Boachie, M.K. (2020), *The environmental impact of industrialization and foreign direct investment, Energy Policy*, 137, 111178, https://doi.org/10.1016/j.enpol.2019.111178.

[26] Ouedraogo, R., Marlet, E. (2018), *Foreign direct investment and women empowerment: New evidence on developing countries. IMF Working Papers*, 18(25), https://doi.org/10.5089/9781484339732.001.

[27] Pegkas, P. (2015), *The impact of FDI on economic growth in Eurozone countries. The Journal of Economic Asymmetries*, 12(2), 124-132, https://doi.org/10.1016/j.jeca. 2015.05.001.

[28] Sachs, J.D., Lafortune, G., Fuller, G., Drumm, E. (2023), *Implementing the SDG Stimulus. Sustainable Development Report 2023. Paris: SDSN*, Dublin: Dublin, Ireland, University Press, 10.25546/102924.

[29] Sdgindex.org. (2023), https://dashboards.sdgindex.org/downloads (Accessed 29 April 2024).

[30] Topalli, M., Papavangjeli, M., Ivanaj, S., Ferra, B. (2021), *The impact of foreign direct investments on poverty reduction in the Western Balkans. Economics*, 15(1), 129-149, https://doi.org/10.1515/econ-2021-0008.

[31] United Nations, (2015), *A/RES/70/1. Transforming our world: the 2030 agenda for sustainable development.* https://documents.un.org/doc/undoc/gen/n15/291/89/ pdf/n1529189.pdf (Accessed 30 October 2024).

[32] Unctad, (2024). *World Investment Report 2024: Investment Facilitation and Digital Government.* New York and Geneva: United Nations.

[33] Wooldridge, J.M. (2010), *Econometric analysis of cross section and panel data*. The MIT Press Cambridge, Massachusetts London, England.

[34] World Bank. (2024), https://databank.worldbank.org/source/world-development-indicators (Accessed 29 April 2024).

[35] Xu, C., Han, M., Dossou, T.A.M., & Bekun, F.V., (2021), *Trade openness, FDI, and income inequality: Evidence from sub-Saharan Africa. African Development Review*, 33(1), 193-203.