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The impact of interest rate hikes on Egypt's green financing gap

Heba Elbaz
Macroeconomic Policies Center, Institute of National Planning, Cairo, Egypt
Fatma Elhamalawy
Center for International Economic Relations, Institute of National Planning, Cairo, Egypt
Aya Alsersy
Environmental Planning and Development Center, Institute of National Planning, Cairo, Egypt
Neveen Ahmed
Macroeconomic Policies Center, Institute of National Planning, Cairo, Egypt
Zainab Elsadi
Regional Development Center, Institute of National Planning, Cairo, Egypt
Marina A. Riad
Macroeconomic Policies Center, Institute of National Planning, Cairo, Egypt
Noran Elkashef
The American University in Cairo, New Cairo, Egypt, and
Hala Abou-Ali
Department of Economics, The Economic Research Forum, Faculty of Economics and Political Science, Cairo University, Giza, Egypt

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Abstract

Purpose – This study aims to empirically analyze the effect of interest rate fluctuations on Egypt's green financing gap. While numerous studies have investigated green finance determinants, no prior research has specifically analyzed the influence of interest rates on the green financing gap.

Design/methodology/approach – This study employs the dynamic ordinary least squares methodology to assess the relationship between interest rate fluctuations and the green financing gap in Egypt. Owing to data limitations and the absence of an established proxy, the "GFG Index" is developed to quantify the green financing gap using available national-level indicators.

Findings – The empirical analysis reveals a significant positive relationship between interest rates and Egypt's green financing gap. An increase in interest rates widens the green financing gap, indicating the adverse impact of contractionary monetary policy on green finance availability and affordability. The study suggests implementing dual interest rates and a suite of central bank measures to address this issue. Complementary fiscal, financial and environmental policies are also proposed to form a comprehensive strategy for green finance.

Originality/value – This study contributes to the literature by exploring the complex relationship between interest rates and the green financing gap and providing the first empirical evidence of how interest rate

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fluctuations affect the green financing gap in Egypt. It introduces the GFG Index as an innovative proxy for the green financing gap. The study offers policy recommendations that integrate central bank instruments with broader green finance strategies, addressing a previously unexplored dimension of green financial policy in developing economies.

Keywords Interest rates, Green finance, Green financing gap, Monetary policy

Paper type Research article

1. Introduction

Financing the green transition is a critical challenge for emerging economies striving to meet climate goals while sustaining economic growth. The scale of investment required for mitigation and adaptation far exceeds the capacity of public budgets, making access to affordable green finance essential. This challenge has intensified following the Russian-Ukrainian War, which disrupted commodity markets, triggered inflation, and led central banks across the world to adopt contractionary monetary policies. The increase in interest rates led to a higher cost of capital, which undermined the availability and affordability of green finance, thereby widening the green financing gap (GFG).

Egypt is no exception. In response to inflationary pressures, the Central Bank of Egypt (CBE) raised interest rate from 10.6% in 2022 to 17.8% in 2023 and further to 24.3% in 2024 (World Bank, n.d.). These hikes, while aimed at macroeconomic stability, have made green projects, characterized by high upfront capital costs coupled with delayed returns, less viable. Higher borrowing costs constrain the financial resources available for financing green investments and achieving sustainable development. Egypt's National Climate Change Strategy 2050 estimates a green financing gap of approximately US$248.3 billion to implement its adaptation and mitigation plans (Ministry of Environment, 2022). This gap is expected to further increase due to recent global and national developments, accompanied by interest rate hikes, tightened global financial conditions, and restricted capital flows.

There is a consensus that interest rates influence the green financing gap, yet the relationship remains largely unexplored through empirical literature. This study aims to fill that gap by profoundly exploring this relationship and empirically investigating the potential impact of interest rate hikes on Egypt's green financing gap employing the Dynamic Ordinary Least Squares (DOLS) methodology. A key challenge lies in evaluating the dimensions of the green financing gap in Egypt considering the scarcity of data. To address this, the study introduces a novel Green Financing Gap Index "GFG Index" tailored to proxy the gap.

The study offers valuable insights into how rising interest rates can hinder progress in closing the green financing gap. As empirical results indicate a positive relationship, increasing interest rates are associated with a wider green financing gap. The findings provide actionable inputs for policymakers to mitigate the negative effects of increasing interest rates on the green financing gap, as well as policy interventions to narrow this gap. One proposed approach is for the CBE to adopt a dual interest rate policy. This could be reinforced by green targeted refinancing lines, differentiated capital or reserve requirements, and incentives to attract green focused foreign direct investment (FDI). Broader fiscal, financial, and environmental reforms will also be needed to enhance green finance in the context of a comprehensive national strategy.

The paper is organized as follows. Section 2 provides a review of the relevant literature, outlining the various types of green financing gaps and the main factors influencing them, facilitating the development of the research hypothesis. Section 3 describes the methodology, and the constructed "GFG Index". Section 4 presents the key empirical finding. Section 5 introduces policy recommendations, and Section 6 concludes with a summary and directions for future research.

2. Literature review and hypothesis development

2.1 Defining and measuring the "green financing gap"

Amid growing global concern for climate change and sustainable development, green finance has emerged as a pivotal tool for mobilizing the required financial resources to achieve the transition to a green sustainable economy (Agrawal *et al*., 2023). Although the "green finance" term is increasingly used worldwide, there remains no universally agreed-upon definition of "green finance". According to the Economic and Social Commission for Asia and the Pacific (n.d.), green finance broadly encompasses funding for environment-oriented technologies, activities, projects, industries, and businesses. It is closely related to the concept of "environmental finance" and can be used interchangeably with "green investment" referring to financial support for activities that yield environmental benefits in the broader context of sustainable development (Rahman *et al*., 2022). It includes "climate finance", though it involves broader environmental objectives. "Green finance" differs from "sustainable finance," which is broader and extends to integrate environmental, social, economic, and governance dimensions (Spinaci, 2021).

Executing a green sustainable transition requires substantial investments and high levels of financing that are currently insufficient, leading to gaps in green financing. Several studies have attempted to explore these growing investment needs, as well as the dimensions of the various types and subcategories of green financing gaps. Bhattacharya *et al*. (2022) and Songwe *et al*. (2022) have assessed the financing gap in achieving development goals. Others have focused on more specific aspects, such as Alayza and Caldwell (2021) that focused on the climate financing gap and UNEP (2022) that examined the adaptation financing gap. Green Finance Institute *et al*. (2021) measured the financing gap for nature-related outcomes. Energy Transition Commission (2022) and Krishnan *et al*. (2022) concentrated on energy transition and reaching net zero financing gaps, respectively. These studies agreed on the insufficiency of financing resources facing investment needs and the existence of persistent financing gaps.

2.2 Factors affecting the "green financing gap"

The relationship between interest rates and the green financing gap remains under-investigated in empirical literature, despite strong theoretical foundations. Classical economists have clarified that investment demand is inversely related to interest rates, and higher capital costs discourage investment and vice versa (Chuba and Ebhotemhen, 2019). Keynes and Fisher indicated that investment continues until the present value of expected future returns matches the cost of capital, emphasizing the inverse relationship between interest rate and investment (Eklund, 2013). Mishkin (1995), through the "Theory of Transmission Mechanism", identified interest rate as a key monetary policy mechanism determining investment and output (Appelt, 2016). Neoclassical and neo-Keynesian economists highlighted the important role of interest rate adjustments in influencing investment decisions (Gordon, 2015).

Empirical studies consistently support this link. Hambur and La Cava (2018) and Shama *et al*. (2020) found a significant negative relationship between interest rates and investment. Extending this to green finance, Desalegn *et al*. (2022) demonstrated that higher lending interest rates negatively impact green finance and reduce investors' profits and willingness to make green investments. Eyraud *et al*. (2013), Aguila and Wullweber (2024), and Van Den Engel *et al*. (2024) emphasized that green investments are particularly sensitive to interest rate changes due to their high upfront capital cost and long payback periods. The upfront capital costs exceed 85% of the total costs for solar, wind, and hydro energy projects, compared with 65 and 30% for coal and gas projects, respectively (Nelson and Shrimali, 2014). Green projects typically have long-return horizons, making them unattractive to investors seeking short-term returns. Their high-risk profile, driven by the sector's relative immaturity and uncertainty, further reduces their appeal. Therefore, to attract investors, returns on green investments should be very high. Achieving such returns is difficult in a high-interest-rate environment (Campiglio, 2016).

While research directly linking interest rates to the green financing gap is, to the best of our knowledge, extremely limited or non-existent, two potential channels can be drawn from existing studies. The first is the "*investment channel*," where decreasing interest rates stimulate green investments, in turn, narrowing the green financing gap (Van Den Engel *et al*., 2024). The second channel, specified as the "*output channel,*" is more complex and indirect, where interest rates affect carbon emissions, sequentially influencing the green financing gap. Qingquan *et al*. (2020) and Van Den Engel *et al*. (2024) explained that lowering interest rates discourages savings and increases consumption and lending levels. This incentivizes producers to increase their production and investment to meet growing demand. Price competition encourages producers to exploit low-cost, high-emission physical capital. Consequently, CO_2 emissions increase. In this initial phase, a negative relationship exists between interest rates and CO_2 emissions, whereas in the next phase, CO_2 emissions positively impact green finance, thereby narrowing the green financing gap.

Based on the literature and theoretical assumptions, we formulated our first hypothesis as follows:

H1. The interest rate has a positive and significant effect on the green financing gap in Egypt.

Most empirical studies support the positive relationship between CO_2 emissions and green finance. Wang *et al*. (2023) and Wu *et al*. (2023) indicated that rising carbon emissions intensify demand for green projects while driving the urgency for mitigation and adaptation measures. Yang *et al*. (2023) explained that rising CO_2 levels augment the pressure on firms to accelerate their low-carbon transition, which necessitates increasing green finance. Empirically supporting this view, Meo and Abd Karim (2022) and Su *et al*. (2024) concluded that CO_2 emissions have a positive impact on green finance as a result of environmental pressures. Enhancing green finance levels to confront CO_2 emissions helps in bridging the gap in green financing. Drawing on this, the second hypothesis is formulated as follows:

H2. Carbon emissions have a negative and significant effect on the green financing gap in Egypt.

Limited evidence exists regarding the relationship between GDP and the green financing gap. Hamurcu (2023) confirmed a direct positive effect of GDP on green finance, as it offers an opportunity to strengthen the orientation towards green investment. Similarly, Eyraud *et al*. (2013) concluded that GDP growth has a significant positive impact on green investments. However, Van Den Engel (2024) found that GDP does not significantly impact green investment. Based on previous studies, the third hypothesis is proposed as follows:

H3. GDP growth has a negative and significant effect on the green financing gap in Egypt.

Several studies emphasize FDI's pivotal role in enhancing green finance by providing funding and technology transfer. Inward FDI benefits for the host country exhibit a positive long-term relationship with green financing, indicating increased assets for the host country that help to tighten the green financing gap (Desalegn *et al*., 2022). Christnacht and Mertzanis (2025) further confirm the positive relationship between FDI and green finance growth, mainly induced by technology transfer benefits, as well as improvement in corporate governance and environmental compliance standards, that enhances investor confidence in green finance markets. Furthermore, Ngo (2024) demonstrated that FDI magnifies the positive impact of the expansionary monetary policy on green finance by injecting additional funds and enabling green project execution. Therefore, the following hypothesis is suggested:

H4. Foreign direct investment inflows have a negative and significant effect on the green financing gap in Egypt.

The financial system plays a significant role in aligning financial flows with environmental targets, mobilizing resources for green investments and bridging the green financing gap, as highlighted by Campiglio (2016), Dikau and Volz (2018), and D'Ozario and Popoyan (2019). Ji and Zhang (2019) and Shandong (2022) found that financial development enhances capital mobilization towards green projects. However, Lv *et al*. (2022) indicated that financial development could negatively impact green finance if resource allocation and investments were oriented towards non-environmentally friendly projects. Based on previous studies, the following hypothesis is developed:

H5. Financial development has a negative and significant effect on the green financing gap in Egypt.

The impact of population growth on green finance remains contested in the literature. Eyraud *et al*. (2013) and Van Den Engel *et al*. (2024) confirmed that population positively impacts green finance owing to the rising demand for energy resulting from population growth, which consequently necessitates increasing investments in alternative sources of energy. Similarly, Vukmirović *et al*. (2024) found that population density boosts green investment, highlighting that infrastructure attracting green investments often exists in densely populated urban areas, as well as larger investors pools resulting in successful green crowdfunding campaigns.

However, population growth does not always positively impact green finance, especially in developing countries. In this regard, Dercon (2014) emphasized that developing countries with high population growth face a serious trade-off between funding poverty reduction and financing greener practices. Population growth diverts finance away from promoting green practices, thus widening the green financing gap. Based on this, the sixth hypothesis is articulated as follows:

H6. Population growth has a positive and significant effect on the green financing gap in Egypt.

3. Data and methodology

To comprehensively examine the complex relationship between interest rates and the green financing gap in Egypt, an explanatory research design and quantitative research approach are employed. Furthermore, an index tailored to serve as a proxy for the green financing gap is constructed. Secondary data were drawn from reliable repositories with an emphasis on leveraging the comprehensive resources provided by the World Development Indicators (WDI), International Monetary Fund (IMF), and Organization for Economic Cooperation and Development (OECD) databases.

3.1 Constructing an index for the green financing gap "GFG index"

The green financing gap refers to the difference between the requisite financial resources necessary to fund environmentally beneficial green investments and the available financial resources to support them. This disparity signifies a misalignment between the demand and supply of the financial resources required for green investments. Data regarding these requirements and flows is often scarce. To address this scarcity, a novel Green Financing Gap Index "GFG Index" is constructed to serve as a valuable tool for quantifying the gap.

The "GFG index" is a metric used to measure the shortfall in financing environmentally sustainable projects or initiatives. It quantifies the difference between the current level of green financing and funding required to achieve environmental goals. The methodology for computing the "GFG index" is context dependent and depends on the goals being assessed. The pivotal dimension shaping the index is the criterion for steering fund mobilization, as discussed later.

To enhance interpretability, the index can undergo normalization or benchmarking, allowing for more meaningful comparisons across regions or periods. Normalizing the "GFG Index" by dividing it by a reference value or benchmark facilitates comparisons. The reference value may represent the percentage of estimated financing required, or any other relevant benchmark. The accuracy and reliability of the index depend on the quality and availability of data, which can be challenging to procure.

The GFG index is calculated based on the following formula:

$$\mathrm{GFG} = (\mathrm{W} * \mathrm{sub} - \mathrm{index}_1) + (\mathrm{W} * \mathrm{sub} - \mathrm{index}_2) + \ldots\ldots + (\mathrm{W} * \mathrm{sub} - \mathrm{index}_n) \quad (1)$$

where GFG is the green financing gap index and watt is the weight assigned to each sub-index.

The "GFG Index" is constructed as a composite measure comprising seven equally weighted sub-indices. To normalize the underlying indicators, the Max-Min procedure is applied, using the observed minimum and maximum values across all countries as reference points (Mazziotta and Pareto, 2013). The resulting "GFG Index" ranges from 0 to 1 each year, where lower values signify a smaller green financing gap and vice versa.

3.2 Model specification

The model is structured following Desalegn *et al*. (2022), with the green financing gap used as the dependent variable and the interest rate as the independent variable. Owing to the lack of data, the "GFG Index" constructed in the previous section is utilized as a proxy for the green financing gap. Additionally, carbon dioxide emissions, GDP growth rate, net foreign direct investment inflows, financial development and population are included as explanatory variables in the model.

The regression equation is formulated as follows:

$$GFG : f\,(I, \mathrm{CO_2}, \mathrm{GDPg}, FDII\mathrm{N}, \mathrm{FD}, \mathrm{POP}) \quad (2)$$

Where (*GFG*) represents the green financing gap index, (I) is the interest rate measured by the lending interest rate, (CO_2) depicts CO_2 emissions measured in tons per capita terms excluding land-use change and forestry, (GDPg) is the GDP growth rate measured by the percentage change in GDP, (*FDII*N) refers to net foreign direct investment inflows measured as a percentage of GDP, (FD) indicates the financial development measured by the IMF's Financial Development Index which consists of several sub-indices reflecting the degree of development of financial institutions and markets, according to depth, access, and efficiency dimensions. Finally, (POP) presents the population growth rate measured by the percentage change in population. This regression equation serves as a compass, guiding our exploration of the intricate relationship between these variables and sheds light on their impact on Egypt's green financing landscape.

Equation (2) can be rewritten as follows:

$$GF\mathrm{G}_t = \beta_0 + \beta_1(\mathrm{I})_t + \beta_2(\mathrm{CO_2})_t + \beta_3(\mathrm{GDPg})_t + \beta_4(FDII\mathrm{N})_t + \beta_5(\mathrm{FD})_\mathrm{t} + \beta_6(\mathrm{POP})_\mathrm{t} + \mu_t \quad (3)$$

This equation highlights the quantitative relationships to be estimated in the following sections.

3.3 Data description

To conduct the analysis, secondary data is collected from a spectrum of reliable sources, encompassing various websites, pertinent publications, and yearly reports. The pivotal data on dependent and independent variables are drawn from reliable repositories, with a particular emphasis on leveraging the comprehensive resources provided by the World Development

Indicators (WDI) database, International Monetary Fund (IMF), and Organization for Economic and Development (OECD) databases.

To reflect the various dimensions of the green financing gap in Egypt, seven indicators are employed to construct the GFG index. These include the mitigation and adaptation-related finance commitments (in thousand USD) from OECD DAC (2000–2021), public climate-related expenditure reported by IMF, and estimated private spending (1995–2020), derived from Climate Policy Initiative's public-private financing ratio. The World Bank's adjusted savings indicator captures the cost of CO2 emissions. Additional indicators include the share of renewable energy in overall energy consumption and the percentage of urban population with access to clean fuels and technologies for cooking.

Data concerning lending interest rates, in addition to CO_2 emissions, GDP growth, net FDI inflows, population growth, and financial development index, covering the period from 1990 to 2023, are extracted from WDI and IMF databases.

4. Results and discussion

4.1 Data exploration

Table 1 provides a comprehensive overview of the descriptive statistics derived from a dataset comprising 34 annual observations across all variables in the study. At the heart of the analysis is the "GFG Index," with a mean of 0.87 points, indicating a notably wide gap in green finance in Egypt. The lending interest rate exhibits an average of 14.1%, fluctuating between a maximum of 20.3% and a minimum of 9.4%. The mean of the CO_2 emissions is 1.96 tCO_2e/capita. The GDP growth rate has a mean of 4.4%, while FDI net inflows, as a percentage of GDP, recorded an average of 2.3%. FD index and population growth mean were 0.29 points and 2.07%, respectively.

As shown in Figure 1 Panel a, the green financing gap in Egypt, as proxied by the GFG index, remains wide during the study period. The scarcity of private and public investments in environmental protection data during the 1990s resulted in their limited contribution to the index. However, climate-related development assistance increased following developed countries commitment in 2009 to support climate finance in developing countries. Renewable energy use and clean fuel access for cooking improved after the adoption of renewable energy strategies, feed-in-tariffs, subsidy cuts, and tax breaks. Despite that, CO2 damage augmented due to industrial and energy use surge in Egypt (Salman and Hosny, 2021).

Figure 1 (Panel b) shows fluctuations in lending interest rates, with a sharp increase following the 2016 currency devaluation and policy reforms. CBE raised interest rates to 18.3% by 2018 to contain inflationary pressures. Rates dropped to 9.4% in 2021 during the COVID-19 policy response, but rose again to 10.6% in 2022, climbing further to 17.8 and

Table 1. Descriptive statistics

	GFG	I	CO_2	GDPg	FDIIN	FD	POP
Mean	0.87	14.13	1.96	4.41	2.30	0.29	2.07
Median	0.87	13.25	2.06	4.42	1.52	0.29	2.08
Maximum	0.98	20.33	2.40	7.16	9.35	0.35	2.93
Minimum	0.75	9.43	1.40	1.13	−0.20	0.24	1.49
Std. Dev	0.07	2.90	0.34	1.56	2.19	0.03	0.29
Skewness	0.00	0.67	−0.23	−0.09	1.98	0.00	0.56
Kurtosis	1.80	2.33	1.40	2.33	6.52	1.80	4.56
Jarque-Bera	2.05	3.15	3.91	0.69	39.86	2.05	5.20
Probability	0.36	0.21	0.14	0.71	0.00	0.36	0.07
Observations	34	34	34	34	34	34	34

Source(s): Authors' own work based on E-views 10

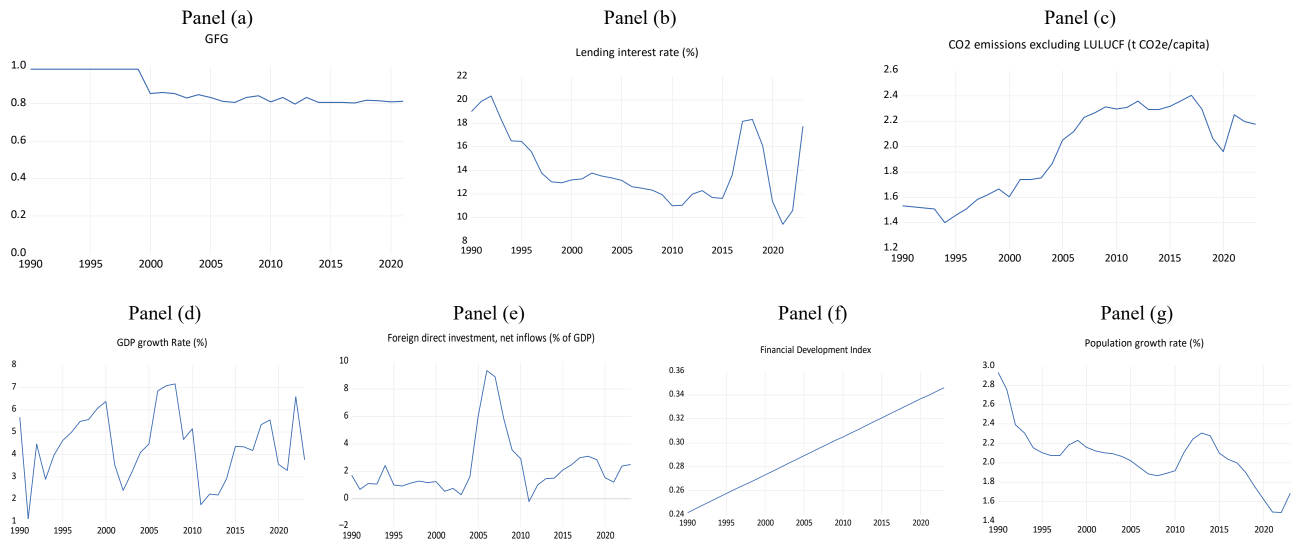

Figure 1. Exploratory visualization of Green Finance Gap Index and the independent variables, Egypt, 1990–2023. **Source(s):** Authors' own work based on data retrieved from the World Bank (n.d.) and IMF (n.d.), using E-views 10

24.3% in 2023 and 2024, respectively. These consecutive increases were mainly induced by the contractionary monetary policy adopted by CBE to curb inflation and confront global shocks.

CO_2 emissions steadily increased after the mid-1990s, peaking at 2.4 tCO_2e/capita in 2017, before declining coinciding with the discontinuation of fossil fuel subsidies (Figure 1 Panel c). GDP growth rate experienced fluctuations (Figure 1 Panel d). Modest in the 1990s, growth rate surged to 7.5% in 1998, slowed in the early 2000s, and rebounded to 7.2% by 2008. Growth fell after the 2011 Arab spring, but gradually recovered until the COVID-19 pandemic, that caused a regress to 3.6% in 2020. Growth rate briefly recovered, recording 6.6% in 2022, before slowing down again due to global and regional tensions. FDI inflows were modest before 2003, but surged between 2004 and 2007, due to improved macroeconomic conditions (Figure 1 Panel e). The 2011 political unrest led to a sharp decline, though inflows of foreign capital partially recovered as relative political stability and institutional reform resumed, before being hit again by the pandemic. As the crisis started to subside, an improvement in inflows began to appear. The FD index increased over the period of analysis from 0.22 in 1990 to 0.31 in 2021 (Figure 1 Panel f), mainly induced by financial markets development rather than by financial institutions (Mohieldin *et al*., 2019). Population growth steadily declined until 2010 (Figure 1 Panel g). This trend was disrupted following the 2011 revolution, which significantly hindered family planning initiatives. From 2015, population growth gradually decreased, supported by renewed measures to address demographic pressure.

Table 2 shows the results of the stationarity test conducted using the Augmented Dickey Fuller (ADF) method. The findings reveal distinct stationarity results for each variable, implying a challenge in employing techniques such as the vector autoregressive (VAR) model, which requires all variables to exhibit the same order of integration. Given the study's objective of capturing dynamic interactions across variables, even in the presence of non-stationarity in the time series, an alternative approach is warranted. This involves conducting a cointegration test, specifically the Hansen Parameter Instability test, which indicates the existence of a long-run equilibrium relationship among the variables, thereby justifying the use of models that account for cointegration.

With the establishment of cointegration signifying a long-run relationship between the variables, a Dynamic Ordinary Least Squares (DOLS) framework is employed for the estimation. DOLS is suitable for handling co-integrated variables, as it enables the consistent

Table 2. Stationarity tests of the variables (*P*-value)

Unit root test results table (ADF)
Null hypothesis: The variable has a unit root

	GFG	I	CO_2	GDPg	FDIIN	FD	POP
With Constant	0.58	0.02	0.8	0.007	0	0.48	0.7
With Constant and Trend	0.67	0.03	0.21	0.035	0.01	0.82	0.56
Without Constant and Trend	0.2	0.25	0.94	0.186	0	0.72	0.34

At first difference

	d (GFG)	d(I)	d (CO_2)	d (GDPg)	d (FDIIN)	d (FD)	d (POP)
With Constant	0	0.01	0.01	0	0	0	0.08
With Constant and Trend	0	0.02	0.04	0	0	0	0.26
Without Constant and Trend	0	0	0	0	0	0	0.01

Lag Length based on SIC
Probability based on MacKinnon (1996) one-sided *p*-values
Source(s): Authors' own work based on output by E-views 10

estimation of long-run coefficients by correcting for potential endogeneity and serial correlation. This makes it appropriate to underscore long-term relationships between variables.

Although the variables show different orders of integration, their linear combinations may still be stationary. The Hansen parameter instability approach supports this claim by confirming a long-term relationship between variables with a probability value greater than 0.2, failing to reject the null hypothesis of cointegration This result advocates the existence of a stable long-run relationship among the variables and justifies using DOLS. DOLS can be used to assess the relationship between variables with mixed integration orders (Masih and Masih, 1996) and it is more suitable for small samples, based on Monte Carlo evidence, making it particularly suitable for this study (Stock and Watson, 1993). The results of the robustness check show the reliability of the model. The residuals are stationary, according to the Augmented Dickey-Fuller (ADF) test. In addition, they follow a normal distribution based on a *p*-value of 0.847 for the Jarque–Bera test and the residuals show no sign of serial correlation.

4.2 Key findings and discussion

The model results, as demonstrated in Table 3, identify the key determinants of Egypt's green financing gap. Five of the six hypothesized relationships are confirmed by the analysis: four at significance levels of 5% (H1, H2, H4, and H6) and one (H3) at the 10% level. Only H5 is not supported.

H1 is supported, indicating that interest rates have a significant and positive effect on the "GFG Index". This suggests that higher interest rates widen the green financing gap. Classical, Keynesian, neoclassical, and neo-Keynesian theories all emphasize that rising interest rates raise capital costs and restrain investment. This is particularly true for green projects, characterized by high upfront capital costs and delayed operational savings. Elevated interest rates reduce the financial appeal of such projects leading to abandoned or postponed green investments. Conversely, low interest rates create favorable conditions for green investments, as future cash flows are less severely discounted. Hence, projects that require significant upfront capital but yield future savings, such as green projects, can attract investors. These findings align with those of Eyraud *et al*. (2013), Desalegn *et al*. (2022), Aguila and Wullweber (2024), and Van Den Engel *et al*. (2024).

Table 3. Model estimation by dynamic ordinary least squares (DOLS)

Dependent variable: GFG
Sample (adjusted): 1992 2020
Fixed leads and lags specification (lead = 1, lag = 1)
HAC standard errors and covariance (prewhitening with lags = 1, Bartlett kernel, Newey-West fixed bandwidth = 4.0000)
No d.f. Adjustment for standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob
I	0.031556	0.002187	14.42926	2.88E−05
CO_2	−0.06296	0.006283	−10.0198	0.000169
GDPg	−0.00505	0.00246	−2.05166	0.095441
FDIIN	−0.00871	0.001754	−4.96803	0.004219
FD	0.676,968	0.039048	17.33676	1.17E−05
POP	0.19015	0.014306	13.29163	4.31E−05
R-squared	0.9963	Mean dependent var		0.8681
Adjusted R-squared	0.9738	S.D. dependent var		0.0745
S.E. of regression	0.0121	Sum squared resid		0.0006

Source(s): Authors' own work based on E-views 10

Alongside the "investment channel", interest rates also influence the green financing gap through the "output channel". Lower interest rates discourage saving while encouraging consumption and borrowing. This drives up demand and incentivizes producers to increase production and investment. To remain competitive, producers may opt for low-cost, carbon-intensive production methods, resulting in increased CO_2 emissions. These increases motivate green finance, consequently narrowing the green financing gap. This explains the confirmation of *H2*, which indicates that CO_2 emissions have a significant negative effect on the green financing gap. This result aligns with those of Wang *et al*. (2023), Meo and Abd Karim (2022), Wu *et al*. (2023), and Su *et al*. (2024).

H3, which posits a negative effect of GDP growth on the green financing gap, is found significant at the 10% level. This suggests a modest role of GDP growth in reducing the green financing gap. This weak influence could be attributed to the misalignment between economic growth patterns and environmental priorities. In Egypt, growth is driven by sectors, such as mining, quarrying, and manufacturing industries, that contribute 24% to GDP, but offer limited support for green objectives (MPED, 2025). This misalignment between economic growth and environmental priorities can weaken the potential of GDP expansion to narrow the green financing gap. These findings partially support earlier observations by Ven Den Engel (2024).

H4 is confirmed, showing that FDI inflows appear to narrow the green financing gap. FDI supplements internal funds, facilitates technology transfer, and often raises environmental compliance standards and corporate governance in host countries. These effects can enhance investor confidence in green finance markets. The findings are consistent with earlier conclusions of Desalegn *et al*. (2022), Ngo (2024), and Christnacht and Mertzanis (2025).

The findings do not support *H5*, as they reveal a significant positive impact of financial development on the green financing gap. This result suggests that financial resources are predominantly directed toward conventional carbon intensive sectors rather than green investments. Without explicit green finance policies, financial development may exacerbate environmental degradation. The findings contradict the results of Ji and Zhang (2019) and Shandong (2022) who suggest a more favorable environmental impact from financial development, though they align with those of Lv *et al*. (2022).

Finally, *H6* is confirmed, showing that population growth significantly widens the green financing gap. As population expands, so does demand for infrastructure, services, and resource intensive development, diverting financial resources away from promoting green projects. This dynamic reflects the developmental tradeoffs faced by countries like Egypt, where addressing basic socioeconomic needs may come at the expense of environmental priorities. These findings diverge from those of Eyraud *et al*. (2013), Van Den Engel *et al*. (2024), and Vukmirović *et al*. (2024), but align with the conclusion of Dercon (2014).

5. Policy recommendations

As highlighted in previous sections, to contain inflationary pressures, the CBE adopted a contractionary monetary policy, that led to consecutive increases in interest rates. The findings of this paper indicate a positive significant relationship between interest rates and the green financing gap in Egypt. Increases in interest rates significantly enlarge the green financing gap and hinder the transition towards a green economy. In addition, the results indicate that financial development in Egypt is associated with a widening green financing gap. This could be attributed to financial development enhancing capital accumulation, that is mainly directed towards non-environmentally friendly projects. Thus, policy interventions to mitigate the adverse effects of the central bank's contractionary monetary policy, especially interest rate hikes, on green investments, as well as greening the financial system, by augmenting financial flows towards sectors that have an environmentally positive impact, are essential to narrow the green financing gap.

Adopting dual interest rates can serve as a protective measure to counteract the adverse effects of rising interest rates on green investment alongside promoting green finance. In the

1970s and the 1980s, when central banks such as Bundesbank and Banque de France adopted a contractionary monetary policy, they exempted strategic sectors from it. Thus, these sectors continued to benefit from credit at the previous favorable rates. Such differentiated rates shield strategic sectors from unfavorable repercussions induced by interest rate increases (Aguila and Wullweber, 2024). Hence, the central bank can require banks to provide green projects with credit at lower interest rates. This could be accompanied by directives such as setting mandatory quotas that allocate a certain percentage of banks' portfolios to green projects and assets.

While some criticize credit allocation policies, such as the administrative setting of interest rates and mandatory quotas, for their perceived interference with monetary policy neutrality, many central banks in developing and emerging economies resorted to these policies as viable solutions to enhance green finance (Dikau and Volz, 2018). The People's Bank of China offers lower interest rates for green projects, while the Reserve Bank of India requires commercial banks to allocate a determined percentage of the total credit to priority sectors, including renewable energy. Furthermore, Bangladesh Bank introduced a minimum credit quota of 5% of total financial institutions credit to the green sector (Campiglio *et al*., 2018).

To enhance green credit, central banks can also adopt green-targeted refinancing lines, offering commercial banks refinancing at lower interest rates, and preferential terms for specified green asset classes. This can be considered compensation for commercial banks for lending at lower-than-dominant interest rates to green projects. These lines are favored, as they incentivize banks to provide green credit instead of intervening directly in their credit policies. In this context, Bank of Japan's provides loans below the market rate to financial institutions that provide credit to priority sectors, including environmental businesses. Bangladesh Bank also offers refinancing lines to commercial banks in preferential terms for green loans (Campiglio *et al*., 2018). Furthermore, the People's Bank of China accepted green loans as part of the standing lending facility (SLF), and green bonds at the AA rating as collateral in its medium-term lending facility (MLF), both of which deliver favorable capitalization and interest rate benefits (Escalante *et al*., 2020).

Additional central bank tools such as differentiated capital or reserve requirements from banks with portfolios showing greater interest in green assets can also be utilized to incentivize banks to provide green credit at lower interest rates. For example, the Central Bank of Lebanon lowered the reserve requirements of commercial banks by 100–150% of the loan value when the bank submitted a certificate of the energy-saving potential of the financed project (D'Orazio and Popoyan, 2019). In addition, the acceptance of carbon certificates as part of commercial banks' legal reserves, as well as exchanging these certificates for loan concessions to green projects, create incentives that promote green finance. Furthermore, adopting green quantitative easing purchase programs that target buying green financial assets, especially green bonds, can provide considerable liquidity to green projects (Campiglio *et al*., 2018).

To effectively bridge the green financing gap, Egypt can construct a coherent integrated green credit policy that incorporates the use of a dual interest rate policy, together with a mix of monetary tools that enhance green finance and credit. Diversifying financial tools and sources of green finance instead of focusing on traditional tools is also critical. Using innovative green finance tools such as the administration of carbon taxes, the adoption of emissions trading systems, and the development of collective platforms, maximizes the final outcomes, and provides additional financial sources that help in bridging the green financing gap. Thus, the use of a green monetary policy to bridge the green financing gap must be coordinated with other policy instruments in the context of a comprehensive strategy for green finance and green economic growth.

This green strategy must also include policy interventions to attract green FDI, as it provides additional financial resources to bridge the financing gap and magnifies the monetary policy positive effects on green finance. These benefits are supported by the results indicating the negative relationship between FDI and the green financing gap. To effectively attract green FDI, the study underlines in the first place, the necessity of setting strict environmental regulations and clear environmental targets, as they demonstrate the government's commitment to achieving environmental goals, consequently increasing investors' confidence. Developing financial infrastructure and providing incentives play important roles in motivating and attracting investors. Incentives can incorporate green preferential rates of corporate income tax, value added tax exemptions, accelerated depreciation of green assets, and customs exemptions on imported inputs. The green strategy can also comprise the establishment of a green special economic zone that provide required infrastructure and offer varied incentives (Lin and Hong, 2022; Wang, 2025).

Finally, the findings of this paper highlight the presence of a negative and modesty significant relationship between GDP growth and the green financing gap, which could be attributed to the fact that growth was driven by sectors with limited environmental impact. To promote a significant impact of GDP growth on the green financing gap, economic growth must align with environmental priorities and goals. Thus, complementary fiscal, financial, and environmental policies and measures aiming at enhancing green growth must be incorporated within the framework of the holistic strategy for green finance and growth.

6. Conclusion

The Central Bank of Egypt, like other central banks, adopted a contractionary monetary policy to confront inflationary pressures resulting from global events. Under this tight monetary policy, interest rates increased considerably. These increases harm green investments by augmenting their capital costs and limiting the financial resources available to finance these investments, thereby widening the green financing gap. Thus, the main objective of this study was to empirically investigate the impact of interest rate hikes on the green financing gap in Egypt using the Dynamic Ordinary Least Squares (DOLS) methodology. To facilitate this analysis, a novel "GFG Index" was introduced to serve as a proxy for the green financing gap.

The quantitative analysis results indicate a significant positive relationship between interest rates and the green financing gap. This finding highlights the adverse influence of contractionary monetary policy on green investment. Two potential channels can transmit the effects of changing interest rates. The investment channel, where decreasing interest rates enhance green investments, in turn reduces the green financing gap; and the output channel, through which lower interest rates enhance production and investment, resulting in higher CO_2 emissions. The emissions increase green finance, consequently reducing the green financing gap. The presence of this negative relationship between CO_2 emissions and the green financing gap is also proven by the model results.

Additionally, the results demonstrate that GDP growth has a negative but slightly significant impact on the green financing gap, underscoring that growth has not been adequately aligned with environmental goals and priorities. FDI inflows significantly reduce the green financing gap by increasing financial resources and facilitating technology transfer. In contrast, financial development in Egypt appears to contribute to a widening financing gap, as capital tend to flow towards non-environmentally friendly projects. The results also indicate that population growth has a significant positive effect on the gap, as it diverts financial resources away from promoting green projects.

The study emphasizes key policy implications. Principally, the findings highlight the need for policy intervention to mitigate the adverse effects of the central bank's contractionary monetary policy, especially interest rate hikes, on green investments and to enhance green finance. Additional interventions to green the financial system are also crucial for narrowing the resultant financing gap. In this context, the study suggests a variety of central bank policies and tools that could be exploited, such as adopting a dual interest rate policy, by offering green project credit at preferential rates that are lower than the prevailing rate. These preferential rates can represent part of a coherent integrated green credit policy that includes a mix of different central bank tools targeting green finance enhancement as well as the tightening of the green financing gap. This policy can include, in addition to dual interest rates, embracing green-targeted refinancing lines, implementing differentiated capital or reserve requirements from banks with portfolios biased towards green assets, accepting carbon certificates as part of these reserves, and adopting green quantitative easing purchase programs.

Using innovative green finance tools, in addition to central bank tools, within the framework of a comprehensive strategy for green finance and growth maximizes the final positive outcomes and provides additional financial sources that help in bridging the green financing gap. It is essential to include additional policy interventions to attract green FDI in this strategy. Such interventions include establishing strict environmental regulations and clear environmental targets, developing financial infrastructure, and providing incentives for investors. Complementary fiscal, financial, and environmental policies and measures aiming at enhancing green growth must be incorporated into the framework of this holistic green strategy. Further research is encouraged to explore the optimal policy intervention mix required to enhance synergies among monetary instruments, fiscal policies, and environmental regulation. Such integrated approach will be important for effectively bridging Egypt's green financing gap and facilitating its transition towards a low-carbon, resilient economy.

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Corresponding author
Aya Alsersy can be contacted at: aya.alsersy@inp.edu.eg