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Green Bonds in Russia: Market and Macroeconomic Factors of Returns

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Abstract. The Russian green bond market is still in its early stage of development but it has been expanding in response to global demand for sustainable finance and domestic economic challenges. This context makes the analysis of factors shaping its performance particularly relevant. The aim of this study is to quantify the influence of macroeconomic variables, such as inflation, GDP growth, Brent oil prices, exchange rate fluctuations, and policy uncertainty, together with market indicators including Moscow Exchange Index, bond yield spreads, credit ratings, and new issuance volume, on the capital returns of Russian green bonds between December 2022 and February 2025. The study proceeds from a hypothesis that both macroeconomic conditions and market sentiment determine green bond performance, with inflation, exchange rates, and bond indices expected to exert the strongest effects. Methodologically, a dynamic panel framework estimated by system Generalized Method of Moments is applied, while Fixed- and Random-Effects models provide robustness checks. The empirical analysis reveals persistence in returns, with a significant positive effect of two-month lagged values. Inflation is positively and significantly associated with returns, while ruble appreciation also exerts a positive effect in the GMM model. The Moscow Exchange Bonds Index emerges as another significant factor, indicating close co-movement with the broader bond market. In contrast, GDP growth, Brent oil, policy uncertainty, credit ratings, yield spreads, and issuance volumes show limited or insignificant influence. These findings enrich the literature on sustainable finance in emerging, resource-dependent economies by highlighting the dominant role of inflation and bond market dynamics. For practitioners, the results reiterate the need to account for inflationary and exchange rate conditions, while regulators should prioritize liquidity and integration of green bonds into established market infrastructure.

Key words: green bonds; sustainability; panel regression; macroeconomic factors; market factors; market sentiment.

JEL D25, E22, G11

1. Introduction

The last few decades have seen a growing global concern in the Issue of environmentally friendly solutions, and green bonds have become indispensable financial tools in the quest to combat climate change and enhance sustainability. Such bonds enable investment in a wide range of economic sectors, including renewable energy, sustainable infrastructure and waste recycling, thereby helping to reduce carbon emissions and promote low-carbon economic growth. Since the introduction of the concept by the European Investment Bank, green bond issuance has grown significantly, increasing from $37 billion in 2014 to over $500 billion in 2021 [1]. This growth underscores the increasing importance of these bonds in addressing environmental challenges and promoting sustainable development.

Despite rapid global growth, the Russian green bond market remains relatively small and at a nascent stage, with the first issuance in 2018 and an overall market volume of 331 billion rubles in the beginning of 2025[1]. Nevertheless, the potential for mobilizing capital towards sustainable projects is substantial. The rising popularity of green bonds in Russia can be attributed to several factors.

First, there is a growing emphasis on sustainable development and adherence to Environmental, Social, and Governance (ESG) principles in line with global trends. Green bonds enable companies to secure funding for environmentally focused projects while also meeting investor expectations and international standards [2].

Second, governmental support plays a pivotal role: the Bank of Russia and other state institutions promote green financial instruments through subsidies, including reimbursement of coupon payments, thereby enhancing their appeal to issuers.

Third, issuance of green bonds provides reputational benefits, strengthening investment attractiveness in both domestic and international markets[2]. Major organizations such as VEB.RF actively participate in such initiatives[3].

The development of green bonds in Russia also reflects broader international and regional dynamics. The global green bond market expanded rapidly, with issuance exceeding $530 billion in 2024, representing approximately 60 % of the ESG bond market. The leading issuers are the United States, China, and the EU[4,5]. In Russia, however, issuance in 2024 amounted to only 2.8 billion rubles[6], with the market dominated by large banks, state companies, and regional entities such as the Moscow region, in contrast to more diversified issuers abroad. Government support, national taxonomy initiatives, and subsidies continue to stimulate the market, but sanctions, verification costs, and the risk of greenwashing remain significant barriers. ACRA forecasts suggest that the volume of ESG bond issuance may reach 50–100 billion rubles in 2025 if additional incentives are implemented[7].

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[6] Bank of Russia. (2025). Debt securities issued on the domestic market, included in the sustainable development sector. Retrieved from https://www.cbr.ru/statistics/macro_itm/sec_st/issue_sector/

[7] ACRA (2023, October 19). Russian ESG bond market: issuance forecast. Retrieved from https://acra-ratings.ru/research/2749/?lang=en

Thus, the Russian green bond market is still in its infancy, but shows growing interest in sustainable finance.

At the same time, the relevance of studying this market is enhanced by the economic and political peculiarities of recent years, such as sanctions, geopolitical instability, and volatility in global energy markets. Understanding the impact of market and macroeconomic factors on capital returns allows investors to develop strategies and manage risks more efficiently. This analysis is also important for regulators aiming to support market growth and improve its credibility.

Given these dynamics, the central *research question* of this study is:

RQ: How do market and macroeconomic factors influence the capital returns of green bonds in the Russian financial market?

This question is particularly significant in the context of geopolitical pressures and macroeconomic instability, which may shape investor behavior differently compared to more developed markets.

The aim of this paper is to quantify the impact of macroeconomic factors (inflation, USD/RUB, Brent oil prices, GDP growth, policy uncertainty) and market factors (Moscow Exchange indices, yield spreads, issuance volume, credit ratings) on the capital returns of Russian green bonds over December 2022–February 2025, employing a dynamic panel (system GMM) with FE/RE robustness checks.

The article is structured as follows. First, it provides an overview of the global and Russian green bond markets, emphasizing the main trends and reviewing the existing literature on the determinants of issuance and performance. Next, it presents the dataset, the variables employed, and the econometric methodology applied in the analysis. After that, descriptive statistics and empirical results are introduced. This is followed by a discussion of the findings, highlighting both theoretical contributions and practical implications. Finally, the article concludes with key insights, limitations, and directions for further research.

2. Literature Review

2.1. Green Bonds Market Development

The development of the green bond market was significant globally that is seen through the recent concentration of published research on the European or global market analyses and could be further divided into several subtopics related to the chosen theme. The growth highlights the increasing significance of green bonds as a mechanism of addressing environmental challenges and promoting global sustainable development. Green bonds become independent financial tools that facilitate investments in sustainable sectors such as renewable energy, sustainable infrastructure and energy efficiency projects, thereby actively reducing carbon emissions and fostering low-carbon economic growth.

Despite the continued growth of the green finance market globally, the Russian green bond market remains at a nascent stage while also indicating substantial potential for mobilizing capital towards sustainable projects [3]. The dynamics of the market volume can be seen in Figure 1.

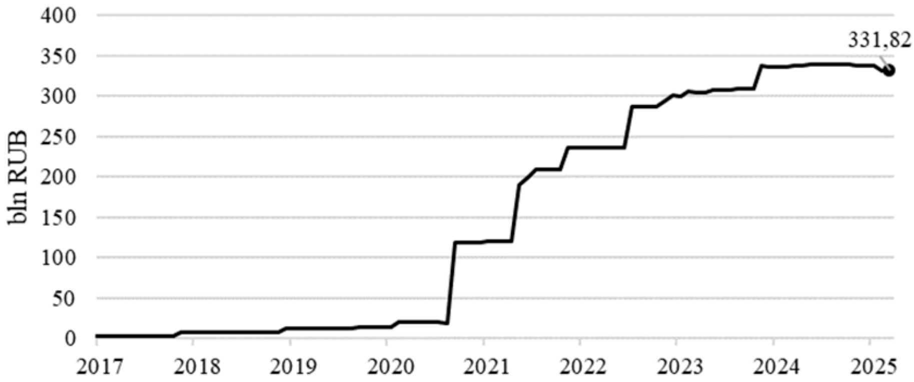

Figure 1. Green Bonds Market Volume

Source. compiled by the authors based on: https://cbonds.ru/indexes/72465/

The growth trajectory of green bonds in Russia reflects a broader global trend where governments and corporations increasingly prioritize environmental sustainability. For instance, studies have shown that countries with robust regulatory frameworks and supportive policies tend to experience higher rates of green bond issuance [4, 5]. In the CIS region, countries like Kazakhstan and Ukraine have also begun to develop their green bond markets, albeit at a slower pace compared to more established markets. Kazakhstan issued its first green bond in 2020, aimed at financing renewable energy projects, while Ukraine has been exploring green financing options as part of its commitment to sustainable development [6]. The comparison demonstrates that while Russia's market is still developing, there is significant potential for growth driven by increasing awareness of climate change and sustainability among investors.

Research on green bond performance has primarily focused on global or regional analyses. For instance, Kanamura [7] questions whether green bonds are both environmentally beneficial and high-performing assets, revealing that their performance is often comparable to conventional bonds.

In a regional context, Shevtsov et al. [6] and Vymyatnina & Chernykh [3] delve into the nuances of green finance in Russia, outlining the importance of institutional frameworks and advocating for enhanced regulatory backing to drive market expansion and effectiveness. These papers show ongoing need to explore how diverse elements shape green bond outcomes across varied economic landscapes while also revealing that despite a growing global literature on green bond performance, a notable knowledge gap persists regarding how these trends manifest in emerging markets such as Russia, where the interaction of macroeconomic signals and market conditions will likely guide future regional studies.

2.2. Determinants of Green Bonds Issuance and Performance

There are many factors which influence the Issue of green bonds. They can be divided into economic, regulatory and related to corporate governance.

Understanding these factors is essential for evaluating the growth and effectiveness of the green bond market, especially in emerging economies like Russia.

Economic factors are among the most significant in determining green bond issuance and performance. Macroeconomic conditions, including GDP growth, inflation rates, exchange rates in the literature are shown to have an impact of new green bonds market volume. A stable economic environment encourages investments in sustainable projects, which leads to increase in the issuance of sustainable bonds.

Dan & Tiron-Tudor [4] outline that higher GDP growth rates correlate with increased green bond issuance because of higher investor confidence and capital availability. In addition, it was noted that fluctuations in oil prices have been shown to impact the probability of corporate green bond issuance.

Azhgaliyeva et al. [8] found that oil price shocks positively affect the likelihood of companies issuing green bonds, as rising oil prices often prompt firms to diversify their energy sources and invest in renewable projects. Dependence on fossil fuels makes companies particularly sensitive to oil price volatility, which may push them to seek sustainable alternatives and further increase the potential profitability of this asset type.

The relationship between the inflation rate and the issuance of green bonds is of great importance, as rising inflation can negatively affect the dynamics of the market for these financial instruments. The study by Azhgaliyeva et al. [8] highlights that higher inflation is negatively associated with investors decisions for green bonds fostering caution due to heightened financing costs that may discourage issuers from entering the market. This is also noted in a study conducted by Dan & Tiron-Tudor [4] that highlights the importance of macroeconomic factors including inflation, in shaping the dynamics of green bond market. As central banks raise interest rates to combat inflation, the financing costs for green bond issues increase, leading to a possible slowdown in market activity.

Moreover, the existing literature highlights the impact of currency fluctuations on the bond market and secondary effects between markets [9, 10]. Confirming this, Ortolano & Angelini [1], in their analysis of green bonds traded on Borsa Italiana, found that the EUR/USD exchange rate in 2017 and 2018 was significant, with a negative sign. This finding indicates that an appreciation of the Euro against the Dollar negatively impacted Green Bonds listed in the European market during that period. Given the specific economic conditions of the Russian market, the USD/RUB exchange rate is expected to have a more direct and prominent influence on the domestic bond market than other currency pairs.

Environmental policies and commitments also drive both issuance and capital returns of green bonds. Specific environmental policies, such as national targets for reducing carbon emissions and increasing renewable energy capacity can drive the issuance of green bonds. Taghizadeh-Hesary et al. [5] highlights that post COVID-19 recovery plans in various countries incorporated green finance as a fundamental component which could be a strategic direction for Russia to enhance the local green bond market. Such commitments are also incorporated within the topic of sovereign and ESG ratings provided by international and local credit rating agencies that analyze the current state of the government [11].

Investors assess creditworthiness and environmental performance, considering various investment risks. Issuers with strong track records, sound environmental management, and effective risk mitigation attract more investment [12, 13]. Based on the European markets analyses result the following *hypotheses* for the recently formed Russian green bonds market could be stated:

H1: Macroeconomic factors including GDP growth, oil prices are positively associated with capital returns of Russian green bonds.

H2: Inflation rate and fluctuations in the USD/RUB exchange rate are negatively associated with capital returns of Russian green bonds.

H3: Credit ratings are positively associated with capital returns of Russian green bonds.

2.3. External Shocks and Geopolitical Factors

Another group of papers emphasizes the role of external shocks and crises in the development of the green bonds' market as well as its performance. The ongoing Russian-Ukraine conflict and previous COVID-19 consequences were analyzed largely for international markets and G7 countries.

Gyamerah & Asare [14] systematically reviews the impact of global economic uncertainty on green bond returns. They find that periods of heightened policy uncertainty often led to increased volatility in this market. In parallel with them, Umar et al. [15] identify the role of US treasury yield curve on green bonds indices with the capturing if volatility shocks.

Mohammed et al. [16] explore the heterogeneous reactions of green and conventional bonds to exogenous shocks, while finding that bonds tend to have lower sensitivity to oil price fluctuations but are more influenced by environmental policy changes. Tao et al. [17] finds significant variability in returns across different market conditions.

The findings of Mertzanis & Tebourbi [18] indicate that not only do all components of the geopolitical risk index correlate positively with green bond issuance, but the effects also exhibit nonlinearity and time delays, suggesting that geopolitical factors can drive growth in the green bond market as investors increasingly seek sustainable investment opportunities during periods of uncertainty.

At the same time one of the recent articles also look at the portfolio hedging within these externally influencing factors on the Russian market, which will be one of the central papers for this discussion [19]. Still the specifics of macro factors uncertainty as geopolitical and economic ones are understudied within the context of developing green bonds Russian market under the threat of external shock. Hence, the following *hypothesis* can be retrieved:

H4: Economic Policy Uncertainty is negatively associated with capital returns of Russian green bonds.

2.4. Market Factors of Green Bond Markets

The increasing interest in green bonds highlights the importance of various market factors influencing their capital returns. Research indicates that overall market sentiment and economic conditions significantly impact investor behavior toward sustainable investments. Issuing green bonds can demonstrate to the market that a company or entity is dedicated to environmental and social sustainability. This commitment can enhance investor interest and foster positive sentiment regarding the company's initiatives [20].

Piñeiro-Chousa et al. [21] find that positive market sentiment correlates with increased demand for green bonds, reflecting investors' desires to align their portfolios with sustainability goals. Additionally, dedicated green bond indices serve as critical benchmarks for evaluating the performance of green bonds relative to conventional bonds. Silva et al. [22] demonstrate that green bonds often outperform traditional alternatives during periods of heightened environmental awareness.

Bond yield spreads between green and conventional bonds also provide insights into investor preferences and perceived risks. Caramichael & Rapp [23] and Khurram et al. [24] suggest that narrower yield spreads indicate greater confidence in green bonds, particularly during favorable regulatory conditions.

Furthermore, higher trading volumes and new issues in the green bond market signal robust investor interest and enhanced liquidity. This interplay of market sentiment, green bond indices, yield spreads, and trading activity underlines the complexity of factors shaping the attractiveness of green bonds, necessitating further exploration in sustainable finance. Therefore, the following hypothesis for the developing market could be stated:

H5: Market factors including market sentiment, bond yield spreads, and new green bonds market volume are positively associated with capital returns of Russian green bonds.

The existing literature on green bonds mainly concerns the EU markets, where yield spreads, greenium, and risk-return ratios are considered [25, 26]. Meanwhile, "green" bonds in emerging economies, and especially in Russia, were not studied well enough, especially since 2022 in the context of geopolitical and economic uncertainty.

The research does not take into account the resource-based economy, where political risks and commodity price volatility are dictated by markets [27], and partially examines the internal rules governing "green" bonds, as, for example, in the case of the Russian approach, which may differ from global standards such as principles of ICMA green bonds. Current research focuses mainly on returns in a liquid market [28]. The comparative lack of empirical research on the Russian green bond market after 2022 indicates the need to study the factors determining the profitability of green bonds in the context of geopolitical instability.

Additionally, this study complements the limited literature on sustainable finance in emerging markets, focusing exclusively on Russia, thereby providing new insights into the effectiveness of green bonds while additional focus on economic policy uncertainty risk and some market sentiment factors as these explores a little-studied aspect of green bond markets.

3. Methodology and Data

3.1. Variables and Data Sources

Consistent with our objective, we quantify the impact of macroeconomic and market factors on the capital returns of Russian green bonds over December 2022–February 2025 in a dynamic panel framework. The empirical design follows several consecutive steps: (1) identification of green bonds included in the official registries of the Moscow Exchange and the Ministry of Finance; (2) collection of daily bond prices and macroeconomic indicators from Cbonds, Rosstat, and the Central Bank of Russia; (3) monthly aggregation of all series to achieve consistency across dependent and independent variables; (4) construction of a dynamic panel dataset with 20 bonds observed across 26 months; (5) estimation of regression specifications using system GMM as the primary method, with FE/RE as robustness checks; and (6) diagnostic testing for validity of instruments, autocorrelation, multicollinearity, and heteroscedasticity.

The novelty of this approach is twofold. First, it introduces a dynamic specification with one- and two-month lags of bond returns, allowing momentum effects to be captured in the Russian green bond market, where liquidity is thin and information diffusion may be delayed. Second, it combines standard macroeconomic drivers (inflation, oil, GDP, exchange rate, policy uncertainty) with market-specific factors (MOEX index, sustainable bond index, yield spreads, trading volume, credit ratings), thereby bridging sovereign and market channels in one unified model. To our knowledge, this is the first study applying system GMM to Russian green bond data under sanctions and volatile macroeconomic conditions.

Firstly, crude oil prices are highlighted as fluctuations in oil prices can significantly impact investor sentiment and the overall economic landscape in Russia. Given the country's reliance on oil exports, changes in crude oil prices can affect government revenues and subsequently influence performance of chosen green projects. Data on crude oil prices will be obtained from the Central Bank of Russia and financial database of Cbonds as Brent prices. Previous studies by Umar et al. [15] and Wang et al. [29] also demonstrated that oil price volatility can significantly impact investor sentiment and the overall economic landscape.

GDP growth rate serves as a critical indicator of economic health. A growing economy often encourages investment in sustainable projects therefore influencing the performance of green bonds. The data for quarterly GDP is retrieved from Rosstat, which provides comprehensive macroeconomic statistics for Russia.

The inflation rate is another chosen variable in the pool of macro factors as it affects purchasing power and can be influenced by interest rates and vice versa, which in turn impacts bond yields. Understanding the inflationary environment is crucial for assessing the attractiveness of green bonds especially in the Russian market context where the inflation is on the high level for the last several years.

Inflation data is readily available from the Central Bank of Russia. Studies have shown that inflation rates can significantly affect investor behavior towards fixed-income securities, including green bonds.

The exchange rate (RUB to USD/EUR) is included, as exchange rate fluctuations can significantly affect foreign investment in green bonds. A stable currency may attract more foreign capital, while depreciation could deter these investments. Exchange rate data is available from the Central Bank of Russia. Ortolano & Angelini [1] and Zhang et al. [30] have noted that exchange rate stability is essential for maintaining investor confidence in emerging markets, where Russia is included.

Credit ratings are retrieved from the specialized reports of major credit rating agencies of Russian Federation (ACRA, Expert RA, NRA, NCR) and provided in a form of ordinal variable. The results of better rating can imply higher investors overview of the specific bond Issue and add to the revenue examined as a dependent variable.

Lastly, this paper will incorporate Russia economic policy uncertainty, which measures uncertainty regarding government policies that can impact investment decisions in green bonds and is shown to influence the stability and performance of green bonds [14]. The impact of policy uncertainty on green financial markets has been well-documented, with implications for both green investments [18].

On the market side, we will analyze the Moscow Exchange Bonds Index as a measure of overall market sentiment and economic conditions that can influence investor behavior towards green bonds. The performance of this index provides insights into how broader market trends may affect investment in sustainable financial instruments.

The Sustainable Bonds composite index from Moscow Exchange will also be included, as it tracks the performance of green bonds issued in Russia. This index provides a direct measure for analysis and allows for comparisons with conventional bond performance. This paper will examine bond yield spreads between green and conventional bonds to indicate investor preferences and perceptions of risk associated with green investments, as well as trading volume of green bonds, as high trading volumes may indicate strong investor interest and liquidity in the green bond market, serving as a proxy for market confidence.

The bond spread is defined as the difference in the yield of green bonds and ordinary bonds with a comparative maturity and identical credit quality. The spread corresponds to a significant indicator describing investors' perception, risk assessment, and market equilibrium in the world of sustainable finance. The spread signifies the difference between the value an investor puts towards purchasing green bonds in relations to conventional bonds with regards to their liquidity, environmental, credit value addition, and other attributes from a certain issuer. When the spread is negative, it means that investors are more than ready to take up low returns for investments that are focused towards developing the environment which suggests there is an "environmental premium" which is driven by environmental value or government policies. A positive spread, on the contrary, may indicate perceived risks, such as reduced liquidity, doubts about the effectiveness of "green" projects, or insufficient certification standards.

Finally, the general volume of the green bond market is incorporated within a variable of new green bonds issuance on the Russian market including additional issues placed during the month in billion RUB. The volume is calculated by the Cbonds agency in a specialized manner every month. As mentioned beforehand, the higher value of the new emissions will show greater interest from investors and therefore positive effect on the returns.

In line with the stated objective, Table 1 summarizes the variables and data sources used to estimate the impact of the listed macroeconomic and market factors on the capital returns of Russian green bonds.

Table 1. **Variables Description**

Variable	Category	Description	Source
Capital Returns	Dependent Variable	Percentage change in bond prices or total return ($Price_1/Price_0 - 1$)	Cbonds (individual bond prices)
GDP Growth	Macro-economic	Percentage change in real GDP (quarterly)	Rosstat
Brent Oil Prices		Brent prices (daily), aggregated in a monthly form	Central Bank of Russia, Cbonds
Inflation Rate		Percentage change in CPI (monthly)	Central Bank of Russia
USD/RUB Exchange Rate Fluctuations		Daily average exchange rate, aggregated in a monthly form.	Central Bank of Russia
Economic Policy Uncertainty		Index score measuring policy uncertainty's impact on investment decisions	Baker et al. [31] policyuncertainty.com
Credit Ratings	Market	Ordinal variable (AAA = 20), derived from agency reports, reflecting bond quality	ACRA, Expert RA, NRA, NCR
Market Sentiment (Moscow Exchange Bonds Index)		Weighted index of bond market performance, reflecting overall market sentiment	Moscow Exchange
Market Sentiment (Sustainable Bonds Composite Index)		Weighted average of yields/prices for sustainable bonds (35 issues)	Moscow Exchange
Bond Yield Spreads		Yield_Green bonds — Yield_Conventional bonds	Cbonds, Moscow Exchange
New Green Bond Market Volume		The volume of new montly issuances (in mln RUB, monthly)	Cbonds

Source: Auth*ors' work*

3.2. Research Design Choice

In order to investigate the research question, this paper will employ a dynamic panel model using data from green bonds issued in Russia. The study will analyze the relationship between the capital returns on these bonds and key macroeconomic indicators with the help of the Generalized Method of Moments on the basis of Ortolano & Angelini [1] methods applied.

To address endogeneity and dynamic feedback effects, we employ a system Generalized Method of Moments as the main estimator, supplemented with fixed-effects (FE) and random-effects (RE) models for robustness. System GMM allows us to use lagged levels and differences of the regressors as instruments, thereby mitigating reverse causality and omitted variable bias. FE captures unobserved heterogeneity among bonds (issuer reputation, covenants, project types), while RE provides efficiency gains under weaker assumptions and serves as a benchmark.

Diagnostic tools include: Hansen J-test for instrument validity, Arellano–Bond test for second-order autocorrelation, Variance Inflation Factor (VIF) for multicollinearity, Breusch–Pagan test for heteroscedasticity, and skewness/kurtosis test for residual normality. This battery of tests ensures that the results are robust despite an unbalanced and relatively short panel.

This design directly implements our objective by estimating the causal impact of macroeconomic and market factors on the capital returns of Russian green bonds (system GMM) with FE/RE robustness. Both models particularly help to address possible cases of endogeneity that stem from the interdependence of the dependent and independent variables, especially in intertemporal data, while the FE model provides for the estimation of less complex static effects.

The Generalized Method of Moments is chosen as the main estimation method for this study due to its robustness in solving econometric challenges related to dynamic panel data analysis, especially in the context of Russia's developing green bond market. Unlike Ordinary Least Squares (OLS), which suffers from bias in the presence of endogeneity and autocorrelation, GMM employs instrumental variables (e. g., lagged macroeconomic indicators) to mitigate reverse causality and omitted variable bias, which is crucial for variables such as oil prices and exchange rates that can jointly influence green bond returns.

In order to add to the GMM approach, the study utilizes a fixed-effects model that is intentionally employed to control for unobserved time-invariant heterogeneity across chosen 20 bonds, such as differences in issuer characteristics or bond-specific risk profiles. The FE model provides a simpler alternative to assess the static effects of macroeconomic and market variables. Given that macroeconomic variables (e. g., exchange rate, inflation) are common to all bonds, and individual variables (e. g., credit rating) vary from bond to bond, the RE (random effect) model provides a valuable approach to assessing their cumulative impact, serving as a reliable benchmark along with fixed effects and a systemic GMM when it is assumed that individual effects are not related to regressors. This approach aligns with the literature, where fixed-effects models are often used alongside dynamic models to provide a comprehensive analysis of panel data [16].

GMM's capacity to model asymmetric effects and time-varying parameter instability aligns with Russia's volatile macroeconomic environment, characterized by oil price fluctuations, geopolitical risks, and abrupt policy shifts. By incorporating system GMM, the study accounts for simultaneous interactions between endogenous regressors (e. g., yield spreads, trading volumes) and external shocks, while Hansen J-tests and Arellano-Bond autocorrelation checks ensure instrument validity and model specification robustness.

Additionally, the Variance Inflation Factor test is conducted to identify and mitigate multicollinearity between independent variables such as macroeconomic indicators (e. g., exchange_rate, infll) and individual credit rating, which may demonstrate interdependence. The Breusch-Pagan test evaluates the presence of heteroscedasticity across the entire panel, while the skewness/kurtosis test verifies the normality of the residuals, eliminating potential deviations that may affect the output. Collectively, these diagnostic tools provide reliable and informed conclusions, despite the complexities associated with an unbalanced panel structure and a diverse set of regressors.

The dataset comprises daily observations of Russian green bonds from December 2022 to February 2025 aggregated in a monthly form, aligning with the availability of bond-specific pricing data for securities classified as "green" under the Russian government's environmental criteria. Green bonds are identified using official registries from the Moscow Exchange and the Russian Ministry of Finance, ensuring compliance with domestic standards for use-of-proceeds verification.

The panel structure includes macroeconomic variables-Brent crude oil prices (USD/barrel), quarterly GDP growth rates (Rosstat), CPI inflation (Bank of Russia), and RUB/USD exchange rates-sourced from the Central Bank of Russia and Bloomberg. Market factors incorporate the Moscow Exchange Index (MOEX), green bond yield spreads (calculated against conventional bonds of matched maturity and credit rating), and trading volumes (Moscow Exchange data). To control for policy shifts, the Economic Policy Uncertainty (EPU) Index for Russia is included. Sustainability factors, such as the sustainability index (sust_index) and credit rating (cred_rating), are also incorporated to explore their role in green bond performance. The dependent variable, capital returns, is derived from individual green bond prices.

Time-fixed effects are incorporated to capture structural breaks, such as sanctions shocks post-2022 and central bank interventions. Lagged returns (1-month and 2-month) are included to model momentum effects. With 20 eligible green bonds and 26 months of post-2022 data, the dataset balances granularity with Russia's nascent sustainable finance landscape.

In order to investigate the impact of chosen market and macro factors on green bonds capital returns, with primarily GMM model and additionally with RE and

FE, the following general view of a regression model is developed and presented as an equation below (1):

$$\begin{gathered} Capital\ returns_{it} = \alpha + \beta_1 \cdot Lagged\ capital\ returns(1)_{it-1} + \\ + \beta_2 \cdot Lagged\ capital\ returns(2)_{it-2} + \beta_3 \cdot GDP\ Growth\ Rate_t + \\ + \beta_4 \cdot Inflation_t + \beta_5 \cdot Brent\ Oil\ Prices_t + \beta_6 \cdot Exchange\ rate_t + \\ + \beta_7 \cdot Economic\ Policy\ Uncertainty_t + \beta_8 \cdot Bond\ Yield\ Spread_t + \\ + \beta_9 \cdot Green\ bonds\ market\ volume_t + \beta_{10} \times \\ \times Sustainable\ Bonds\ Composite\ Index_t + \beta_{11} \cdot Credit\ Ratings_{it} + \\ + \beta_{12} \cdot Moscow\ Exchange\ Bonds\ Index_t + \varepsilon, \end{gathered} \tag{1}$$

where: α — the intercept; β — the slope; i — bond identifier (cross-sectional dimension); t — month (time dimension); *Lagged capital returns* — lagged monthly return of bond i; *GDP Growth Rate* — quarterly GDP growth rate; *Inflation* — CPI inflation; *Brent Oil Prices* — Brent oil price; *Exchange rate* — RUB/USD exchange rate; *Economic Policy Uncertainty* — economic policy uncertainty index; *Bond Yield Spread* — spread between green and conventional bonds; *Green bonds market volume* — the volume of new monthly issuances; *Sustainable Bonds Composite Index* — weighted average of yields/prices for sustainable bonds; *Credit Ratings* — bond credit rating (ordinal); Moscow Exchange Bonds Index — weighted index of bond market performance; ε — the error term.

Stata 14 software is used for the econometrics analysis provided in further sections Descriptive Statistics and Results of this paper.

3.3. Descriptive Statistics

The descriptive statistics of the variables used in this study are presented in Table 2, which provides an overview of a dataset comprising 20 bonds for the period from December 2022 to February 2025. The data set is presented in two forms: daily data with 8,385 observations and monthly aggregated data with 421 observations, reflecting the transition from a high-frequency to a low-frequency panel regression analysis format. These statistics provide insight into the main trends, variability, and range of variables, including the dependent variable of return on equity and explanatory variables.

Table 2. **Descriptive Statistics**

Variable	Obs	Mean	Std. Dev.	Min	Max
Daily data					
Capital returns	8385	–.00014	.0057418	–.03708	.040973
Price	8385	86.6416	18.05188	14.075	108.97

End of table 2

Variable	Obs	Mean	Std. Dev.	Min	Max
Data aggregated by month					
Capital returns	421	–0.00011	0.001346	–0.00806	0.005656
Lagged capital returns (1)	421	0.000497	0.007982	–0.01805	0.119
Lagged capital returns (2)	419	–0.00018	0.001697	–0.00781	0.007169
GDP Growth Rate	421	3.170424	2.749808	–2.7	5.5
Inflation	421	7.571113	2.433029	2.31	11.94
Brent Oil Prices	421	80.54063	5.101401	72.83238	92.445
Exchange rate	421	90.42658	7.937903	69.56164	103.5808
Economic Policy Uncertainty Index	421	339.1563	143.8302	94.5113	650.5323
Bond Yield Spread	421	–2.03052	1.567914	–5.52189	0.847313
Green bonds market volume	421	2.925789	10.83884	0	55
Sustainable Bonds Composite Index	421	103.7237	1.893704	100.8294	107.408
Credit Ratings	421	18.32236	2.343277	12	20
Moscow Exchange Bonds Index	421	223.7788	6.573822	210.7343	233.115

Source: Authors' work

These statistics collectively underscore the diverse economic and market conditions shaping green bond returns in Russia, with implications for their sensitivity to oil prices, monetary policy, and market dynamics explored in the subsequent regression analysis.

4. Results

4.1. Correlation Results

The correlation matrix presented in Table 3 below elucidates the relationships among variables influencing green bond capital returns in Russia, based on 421 monthly observations. Capital returns exhibit a significant positive correlation with lagged returns (0.195 and 0.666), suggesting persistence in return pattern, with stronger association with the two-period lag. The relationship with macroeconomic variables is rather weak in the provided dataset for economics, brent oil prices, exchange rates suggesting a modest inverse association, suggesting limited direct impact from macroeconomic factors. Oppositely GDP growth shows a moderate negative correlation with capital returns (–0.139) and lagged ones.

The Moscow Exchange Bonds Index exhibits a positive correlation with capital returns (0.165), suggesting some co-movement with conventional bonds.

The sustainable bond index shows a strong positive correlation with bond yield spread (0.681) and a moderate one with the bond market index (0.492) that might indicate the alignment with broader bond market trends. Green bonds market volume shows a positive correlation with economic policy uncertainty (0.349) and bond yield spread (0.320), suggesting that issuance activity increases during periods of uncertainty and yield variability. Economic policy uncertainty is positively correlated with capital returns (0.193) and lagged ones on a 2-month period (0.240), but negatively with inflation and economic growth, reflecting its broad influence on market dynamics. Credit ratings show no significant correlations with any variables, indicating limited influence on green bond returns in this dataset.

4.2. Regressions Results

This study investigates the factors influencing capital returns on green bonds in the Russian market using a dynamic panel data approach with Generalized Method of Moments (GMM) estimation, supplemented by a fixed-effects model for robustness. The dependent variable, capital_returns, is constructed as the relative change in bond prices ((price — lag_price) / lag_price), with missing values addressed through monthly aggreagation. Explanatory variables include macroeconomic indicators of GDP Growth Rate, Inflation, Brent Oil, Exchange rate, Economic policy uncertainty, and market-specific factors of Bonds yield, Green bonds market volume, Sustainable bonds index, Moscow Exchange Bonds Index, Credit Ratings.

Empirical analysis reports the estimation results of five panel data models employed to examine the determinants of the green bond capital returns over the period from December 2022 to February 2025. The models are classified into two groups depending on the data frequency: Generalized Method of Moments, Random Effects and Fixed Effects models, modified Random Effects (RE modified), and modified Fixed Effects (FE modified) models with monthly aggregated data. The results, as shown in Table 3 models (1) to (5), demonstrate the dynamic and structural determinants of yields on 20 bonds.

The GMM model was estimated. The model with 419 observations yields an F-statistic of 11.56 ($p < 0.001$), indicating strong joint significance. The regression results indicate that the one-period lagged capital returns have no significant effect on current capital returns. The two-month lagged capital returns exhibit a positive and significant coefficient of 0.326 ($p = 0.002$), indicating that returns from two periods prior positively influence current returns, potentially reflecting momentum or persistence in the green bond market.

Among the chosen macroeconomic variables GDP growth shows a negative but insignificant coefficient. Inflation has a small effect (0.000076) which is significant at the 5 % alpha level and indicates that higher inflation slightly increases green bond returns, possibly due to investor perceptions of green bonds as inflation-resilient assets. Exchange rate provides us with small significant coefficient of 0.0000228 at % level. Brent oil prices and economic policy uncertainty show negligible and insignificant effects, suggesting that these variables do not directly influence green bond returns in this sample.

Bond yield spread, Green bonds market volume also shows a negative coefficient which is also insignificant. Potentially, higher issuance volumes may dilute returns, possibly due to increased supply reducing bond prices. The sustainable bond index and credit ratings show insignificant effects, with coefficients of –0.0000222 and 0.0000169 respectively.

The Moscow Exchange Bonds Index, however, has a positive and significant effect (0.0000369, $p = 0.015$), suggesting that broader bond market performance positively influences green bond returns, reflecting some degree of co-movement. The constant term is negative and significant (–0.006365, $p = 0.229$), though its statistical significance is weak (Table 3).

The RE and FE models estimated using monthly observations show distinct patterns with regard to the determinants of capital returns. Additionally modified models build on the baseline estimations by incorporating additional time-specific effects through monthly dummy variables (month_1 to month_11) and progressively refining the model specifications shown in Table 4 models (2) to (5).

Across models (2) to (5), the one-period lagged capital returns consistently exhibit a positive coefficient of an average 0.016 though the effect remains statistically insignificant in FE models. The two-month lag capital returns show a positive and statistically significant effect on all models of an approximate of 0.46 (p-values < 0.001). The FE models (3 and 5) yield slightly higher coefficients for 2 month lagged returns than the RE models, indicating that controlling for unobserved heterogeneity at the bond level strengthens the evidence of return persistence.

Macroeconomic variables display mixed effects. GDP growth has a negative coefficient across all models but remains insignificant outlining economic growth does not significantly influence green bond returns. Inflation shows a positive and significant effect in models (2) to (3), with average coefficient of 0.00006, but the effect diminishes and becomes insignificant in models (4) and (5). This indicates that inflation's impact on green bond returns is sensitive to the inclusion of time effects in the specification models. Brent oil prices consistently show small and insignificant coefficients across all models suggesting limited direct influence on green bond returns, while exchange rate provide significant coefficients in models (4) and (5) with a negative sign coefficient (0.00006).

The economic policy uncertainty index has a small positive coefficient that remains insignificant across all models as well as Bond yield spread and Green bonds market volume. Credit ratings variable remains insignificant across all models, with coefficients near zero. The Moscow Exchange Bonds Index has a positive and significant effect in models (4) and (5) (0.000389 and 0.000414, $p < 0.01$), indicating that broader bond market performance positively influences green bond returns, an effect more robust in the modified specifications.

Table 3. Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) capital_returns	1												
(2) lag_capital_returns	0,195	1											
(3) lag2_capital_returns	0,666	0,134	1										
(4) gdp_growth	–0,139	–0,096	–0,073	1									
(5) infl	0,031	0,002	–0,058	–0,082	1								
(6) brent	–0,075	–0,017	–0,094	0,223	–0,141	1							
(7) exch_rate	–0,019	–0,089	0,033	0,695	–0,057	–0,154	1						
(8) econ_un_index	0,193	0,040	0,240	–0,249	–0,379	–0,061	–0,076	1					
(9) bonds_yield	–0,068	–0,006	0,001	0,548	–0,241	–0,149	0,248	–0,131	1				
(10) new_bonds_volume	0,018	–0,004	0,070	0,086	0,036	–0,110	–0,091	0,349	0,320	1			
(11) bonds_index	0,165	0,123	0,160	–0,257	–0,445	0,255	–0,392	0,430	0,170	0,153	1		
(12) sust_index	0,041	0,016	0,052	0,385	–0,250	0,212	0,206	–0,072	0,681	–0,107	0,492	1	
(13) cred_rating	0,045	0,065	0,021	0,006	0,027	–0,034	–0,003	–0,022	0,050	0,028	–0,009	0,011	1

Source:Authors' work

Table 4. **Regression Models Results**

	(1)	(2)	(3)	(4)	(5)
	GMM	RE	FE	RE modified	FE modified
Lagged capital returns (1)	–0.0161	0.0161*	0.0159	0.0169*	0.0166
	(–1.29)	(1.79)	(1.55)	(1.83)	(1.58)
Lagged capital returns (2)	0.326***	0.495***	0.485***	0.478***	0.465***
	(3.67)	(5.22)	(4.78)	(5.34)	(4.89)
GDP Growth Rate	–0.0000426	–0.0000331	–0.0000354	0.00000162	–0.000000625
	(–1.39)	(–1.35)	(–1.44)	(0.04)	(–0.01)
Inflation	0.0000760***	0.0000619***	0.0000662**	–0.00000884	–0.00000621
	(5.24)	(2.59)	(2.78)	(–0.17)	(–0.11)
Brent Oil	–0.0000151	–0.00000312	–0.00000428	–0.0000124	–0.0000131
	(–0.95)	(–0.20)	(–0.26)	(–0.52)	(–0.51)
Exchange rate	0.0000228**	0.0000109	0.0000117	–0.0000619***	–0.0000628***
	(2.29)	(1.28)	(1.38)	(–3.25)	(–3.24)
Economic Policy Uncertainty Index	0.000000458	0.000000293	0.000000337	0.000000166	0.000000236
	(1.03)	(0.63)	(0.71)	(0.20)	(0.28)
Bond Yield Spread	–0.00000184	–0.0000482	–0.0000458	–0.000203	–0.000199
	(–0.03)	(–0.77)	(–0.72)	(–1.42)	(–1.32)
Green bonds market volume	–0.00000402	0.000000526	0.000000279	–0.0000201	–0.0000212
	(–0.79)	(0.09)	(0.05)	(–1.35)	(–1.39)

Continuation of table 4

	(1)	(2)	(3)	(4)	(5)
	GMM	RE	FE	RE modified	FE modified
Sustainable Bonds Composite Index	–0.0000406	0.0000327	0.0000440	0.000375**	0.000394**
	(–0.68)	(0.39)	(0.49)	(2.48)	(2.49)
Credit Ratings	0.0000222	0.0000170	–0.000143	0.0000169	–0.000132
	(1.37)	(1.14)	(–0.86)	(1.18)	(–0.94)
Moscow Exchange Bonds Index	0.0000389**	0.0000187	0.0000140	–0.0000340*	–0.0000414*
	(2.68)	(1.30)	(0.94)	(–1.74)	(–1.98)
month_1				–0.00193***	–0.00198**
				(–2.59)	(–2.60)
month_2				–0.00218***	–0.00223***
				(–3.05)	(–3.05)
month_3				–0.00219***	–0.00225**
				(–2.85)	(–2.85)
month_4				–0.00183**	–0.00189**
				(–2.29)	(–2.31)
month_5				–0.00245***	–0.00251***
				(–3.08)	(–3.10)
month_6				–0.00240***	–0.00247***
				(–3.08)	(–3.16)

End of table 4

	(1)	(2)	(3)	(4)	(5)
	GMM	RE	FE	RE modified	FE modified
month_7				-0.00241^{***}	-0.00248^{***}
				(–3.11)	(–3.17)
month_8				-0.00218^{***}	-0.00224^{***}
				(–3.40)	(–3.46)
month_9				-0.00191^{***}	-0.00196^{***}
				(–2.97)	(–3.05)
month_10				-0.00175^{***}	-0.00181^{***}
				(–3.17)	(–3.25)
month_11				-0.00114^{**}	-0.00118^{**}
				(–2.56)	(–2.64)
_cons	–0.00636	–0.00920	–0.00640	-0.0235^{**}	-0.0210^{*}
	(–1.24)	(–1.26)	(–0.76)	(–2.05)	(–1.78)
N	419	419	419	419	419

Notes: t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Authors' work

The inclusion of monthly dummy variables (month_1 to month_12) reveals significant time effects, particularly in models (4) and (5), where coefficients are negative and significant ($p < 0.01$), suggesting seasonal or cyclical patterns in green bond returns. Generally, FE models (3 and 5) tend to produce slightly larger coefficients for significant variables of lagged returns and Bonds index likely due to their ability to control for unobserved bond-specific effects, while the RE models (2 and 4) provide more conservative estimates. Overall, the results highlight the importance of lagged returns, inflation, bond market dynamics, as key drivers of green bond returns, with the modified RE and FE models offering more nuanced insights into temporal effects

The diagnostic tests for the Random Effects and Fixed Effects models assess the validity of the regression assumptions. The Skewness/Kurtosis tests for normality evaluate whether residuals are normally distributed. The Breusch-Pagan/Cook-Weisberg tests check for heteroskedasticity, with chi-squared values (5.76 for RE, 2.99 for modified RE) showing no significant heteroskedasticity ($p = 0.0164$ and 0.0837, respectively), supporting constant variance. The Variance Inflation Factor test is below 5. The Hausman Test results in supporting the use of the RE model over the FE model.

5. Discussion

Brent oil prices now exhibit a negligible and insignificant effect across models, contrasting with prior findings of a negative contemporaneous impact and positive lagged effect. This shift diverges from Azhgaliyeva et al. [8], who document negative oil price shocks on green bond returns in oil-exporting economies. The lack of influence in Russia may reflect a decoupling of oil price movements from green bond performance, distinguishing it from Doğan et al. [32], where oil effects are more pronounced, possibly due to the market's evolving structure or geopolitical insulation.

The significant positive coefficient on MOEX Bonds Index in the GMM model highlights the supportive role of broader bond market performance. This suggests that green bond returns in Russia are closely tied to conventional bond market trends, a linkage not captured in other models due to its static framework. Cicchiello et al. [33] argue that green bond issuance often correlates with overall bond market conditions, as investor sentiment and liquidity spill over from traditional segments. In Russia, this could reflect a market where green bonds are not yet a distinct asset class, as Ferrer et al. [12] suggest, but rather co-move with conventional bonds, particularly given the low variability of Sustainable index and its insignificance. This contrasts with Flammer's [25] findings on corporate green bonds in developed markets, where environmental commitment drives distinct performance.

The GDP growth effect, now insignificant throughout, challenges Anh Tu et al. [34], who link economic growth to green investment, potentially indicating a preference for conventional sectors in Russia, as Klimanov & Kazakova [35] suggest with other variables mediating this relationship. Similarly, Economic Policy Uncertainty shows no significant effect, contrasting with Gyamerah & Asare [14], who link global policy uncertainty to green bond volatility. Russia's unique geopolitical context, compounded by sanctions and energy focus, may mute this relationship, as Mertzanis & Tebourbi [18] note in broader green bond growth studies.

Oppositely, inflation now shows a significant positive effect across models, partially aligning with Dan & Tiron-Tudor [4], who emphasize interest rate impacts on green bond issuance. This suggests that rising inflation enhances green bond returns, possibly due to increased investor appetite for inflation-resilient assets amid Russia's inflationary pressures. Inflation expectations can lead investors to revalue green bonds as inflation hedges or as instruments aligned with long-term environmental policies, increasing demand and prices. Exchange rates now show a small but significant positive effect in the GMM model, aligning with Ortolano & Angelini [1], who highlight exchange rate impacts on capital returns. This suggests that currency appreciation may enhance green bond attractiveness, possibly reflecting foreign investor interest, a nuance not captured in prior findings.

Market-specific factors like Bonds Yield, Green Bonds Market Volume, and Credit Ratings also lack significance, challenging findings from Ballester et al. [11] on credit risk's role in green bond pricing or Caramichael & Rapp [23] on issuance premiums. This could reflect Russia's green bond market's limited differentiation from conventional bonds, where liquidity and investor preferences remain underdeveloped, as Mheiri & Nobanee [36] discuss in their paper. The absence of a green premium, as explored by Kanamura [7], further supports this interpretation.

These findings contribute to the sustainable finance literature by underscoring Russia's green bond market reliance on conventional bond performance rather than oil prices, macroeconomic indicators, or environmental signals. Policymakers might prioritize liquidity enhancement and market segmentation, as Taghizadeh-Hesary et al. [5] recommend, while investors could focus on bond market trends for strategies. Future research could employ quantile-based approaches [17] or issuer-level data [37] to uncover nonlinear effects or environmental influences, building on Vymyatnina & Chernykh [3], particularly as Russia's sustainable finance ecosystem matures amidst global climate challenges.

The regression results provide a mixed evaluation of the hypotheses concerning the determinants of Russian green bond capital returns.

Hypothesis *H1* assuming a positive association between GDP growth, oil prices and capital returns, is not supported, as the effect remains insignificant across models. It is assumed that economic growth does not enhance green bond performance, possibly due to a preference for conventional sectors as Klimanov & Kazakova [34] note. Brent oil prices also showed a negligible and insignificant effect, diverging from expectations of oil-driven market dynamics [8], potentially reflecting a decoupling in Russia's evolving market.

Hypothesis *H2*, predicting a negative relationship with inflation and exchange rate (USD/RUB). This contrasts with the findings of Azhgaliyeva et al. [8] and suggests that a little increase in inflation enhances returns. It is assumed that the limited supply and a narrow circle of issuers in the Russian green bond market create a shortage effect, raising prices. In addition, inflationary expectations may lead investors to value green bonds as a means of hedging inflation or as instruments consistent with long-term environmental policies that increase demand and prices. Suggestions about the exchange rate impacts are not confirmed, with a small but significant positive effect on the GMM model implying currency appreciation boosts green bond attractiveness.

Hypothesis *H3*, expecting a positive association with credit ratings, is not supported, as the effect remains insignificant, challenging Ballester et al. [11] and reflecting limited market differentiation.

Hypothesis *H4* about a negative policy uncertainty effect, is unsupported, with no significant impact, possibly due to Russia's unique geopolitical insulation.

Hypothesis *H5*, linking market sentiment (sustainable bonds index and bonds index) to positive returns, is partially supported, with the bonds index showing a significant positive effect, while the sustainable index remains insignificant, indicating reliance on conventional market trends. The same hypothesis *H5*, predicting positive effects from bond yield spreads and new bond volume, are not supported, with both remaining insignificant, consistent with Kanamura [7] on the lack of a green premium and underdeveloped liquidity, underscoring Russia's nascent green bond market dynamics.

The regression analysis of Russian green bond capital returns provides several actionable recommendations. The significant impact of inflation on returns indicates the necessity for effective inflation control. Fixed-coupon green bonds could be promoted by issuers as appealing investments during inflationary periods, as rising inflation increases market rates, lowers bond prices, and boosts yields for new investors.

Furthermore, the little but noteworthy positive impact of the exchange rate means that issuers and investors should take advantage of the ruble's strengthening period. Issuers can Issue "green" bonds in foreign currency to attract foreign capital, and investors can calculate the time to enter the market to maximize profits. Issuers could create green bonds with foreign currencies in order to attract foreign capital and investors could time market entry to maximize returns. The positive impact of the conventional bonds index suggests that green bonds may be assimilated into wider fixed-income markets, with issuers promoting them alongside traditional bonds and regulators establishing integrated market infrastructure (green bond indices). These strategies can address this nascent green bond market constraints and foster sustainable investment growth.

Despite the robustness of the applied methodology, several limitations should be acknowledged.

First, the dataset spans only 26 months and includes a relatively small number of bonds, which may restrict the generalizability of results.

Second, the Russian green bond market is highly concentrated, with limited issuer diversity and liquidity, which could bias outcomes toward market-specific dynamics rather than universal determinants.

Third, while national-level macroeconomic indicators such as GDP growth, inflation, and exchange rate are included, bond-level heterogeneity (maturity, sectoral allocation, project type) is only partially controlled through credit ratings. Fourth, system GMM relies on instrument validity and may be sensitive to small-sample bias, even though diagnostic tests mitigate these risks.

Finally, Russia's unique geopolitical environment, formed by sanctions and heavy dependence on energy exports, limits the external applicability of the findings to other emerging or developed economies.

These limitations highlight the need for caution in interpretation and point to the importance of future research using longer time spans, cross-country comparisons, and issuer-level data.

By merging Russia-specific insights with global green bond research, this study fills a literature gap by examining how resource-rich emerging economies transition to sustainable finance while accounting for both macroeconomic and market influences. This work uniquely reveals a positive inflation effect, partial confirmation of conventional bonds index influence, and exchange rate appreciation boosting green bond yields, with lagged GMM model analysis enhancing rigor in a data-constrained market.

6. Conclusion

The purpose of this study was to assess how macroeconomic and market factors influence the capital returns of Russian green bonds. This objective has been achieved by applying a dynamic panel methodology, which allowed us to capture both lagged effects and endogeneity issues in a developing and data-constrained market.

The analysis revealed that inflation is the strongest and most consistent driver of green bond returns in Russia, while exchange rate appreciation also exerts a small but positive effect. In addition, the performance of the wider bond market, as reflected by the Moscow Exchange Bonds Index, shows a significant relationship with green bond returns. These findings indicate that Russia's green bond market is strongly shaped by general financial dynamics and macroeconomic stability rather than by oil prices, GDP growth, or policy uncertainty, which remained insignificant. Market-specific variables such as credit ratings, bond yield spreads, and issuance volumes likewise demonstrated limited explanatory power, underscoring the early stage of market development.

From a theoretical perspective, the results contribute to the literature on sustainable finance by highlighting that in a resource-dependent emerging economy, conventional financial and inflationary dynamics outweigh environmental or sector-specific signals. This enriches the understanding of how green bond markets evolve outside established financial centers and under conditions of geopolitical and macroeconomic volatility.

From a practical perspective, the findings suggest that issuers may benefit from positioning green bonds as instruments resilient to inflationary environments and attractive during currency appreciation periods. Regulators could focus on strengthening overall bond market infrastructure, enhancing liquidity, and reducing segmentation between conventional and sustainable instruments. Investors, in turn, may consider monitoring general bond market trends rather than relying on environmental or issuer-specific signals when forming strategies in Russia's green bond segment.

At the same time, the results should be interpreted with caution due to the relatively short observation period and the limited number of instruments in the market. Future research could broaden the sample and explore nonlinear effects or cross-country comparisons to deepen the understanding of sustainable finance in emerging economies.

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Зеленые облигации в России: рыночные и макроэкономические факторы доходности

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Аннотация. Российский рынок зеленых облигаций находится на начальном этапе развития, однако демонстрирует рост вследствие глобального спроса на устойчивое финансирование и внутренних экономических вызовов. В этих условиях особенно актуальным становится анализ факторов, определяющих динамику доходностей. Цель исследования заключается в количественной оценке влияния макроэкономических переменных (инфляции, темпов роста ВВП, цен на нефть Brent, колебаний обменного курса и неопределенности экономической политики), а также рыночных индикаторов (индекс Московской биржи, спреды доходности облигаций, кредитные рейтинги и объем новых размещений) на доходность зеленых облигаций в России в период с декабря 2022 г. по февраль 2025 г. Авторы исходят из гипотезы, согласно которой на результаты инвестиций в зеленые облигации одновременно воздействуют как макроэкономические условия, так и рыночные настроения, при этом наибольшее влияние оказывают инфляция, валютный курс и динамика биржевых индексов. Методологически применен динамический панельный подход с использованием обобщенного метода моментов, а для проверки устойчивости результатов задействованы модели с фиксированными и случайными эффектами. Эмпирический анализ выявил устойчивость доходностей, в частности статистически значимый положительный эффект с лагом в два месяца. Инфляция оказывает положительное и значимое влияние на доходность, а укрепление рубля имеет позитивный эффект в модели обобщенного метода моментов. Существенным фактором выступает динамика индекса облигаций Московской биржи, что отражает тесную связь между зелеными облигациями и более широким облигационным рынком. Напротив, рост ВВП, цена нефти Brent, неопределенность политики, кредитные рейтинги, спреды доходности и объем эмиссии показали ограниченное либо статистически незначимое влияние. Полученные результаты обогащают литературу по устойчивому финансированию в развивающихся экономиках, зависящих от природных ресурсов, выявляя доминирующую роль инфляции и рыночной динамики облигаций. Для практиков выводы исследования подчеркивают необходимость учитывать инфляционную среду и валютные колебания, а для регуляторов — приоритетность обеспечения ликвидности и интеграции зеленых облигаций в существующую рыночную инфраструктуру.

Ключевые слова: зеленые облигации; устойчивое развитие; панельная регрессия; макроэкономические факторы; рыночные факторы; рыночные настроения.

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