Assessing Green Bond Yield Differentials: A Multi-Method Exploration

M2 EGR 2024-2025 Empirical Project: Final Report

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Outline

Introduction

- **Green bonds** finance projects with positive environmental outcomes.
- **Research Question:** Do green bonds trade at a yield differential (greenium) compared to conventional bonds?
- **Importance:** Identifying whether sustainability credentials affect bond pricing.

Empirical Strategy

We use three complementary approaches:

- **Matching Analysis:** Pair similar green and conventional bonds (one-to-one and one-to-many).
- **Panel Regression:** Control for bond characteristics and macroeconomic factors.
- **Nelson–Siegel–Svensson (NSS) Model:** Estimate yield curves for both bond types.

Matching Method Overview

- **Objective:** Isolate the effect of the "green" label.
- **Process:**
  - Standardize bond attributes (coupon, days to maturity, etc.).
  - Use the Hungarian algorithm for optimal one-to-one matching.
- **Key Result:** One-to-one matching shows a negative yield gap of roughly 20–25 basis points.

Matching Method Results

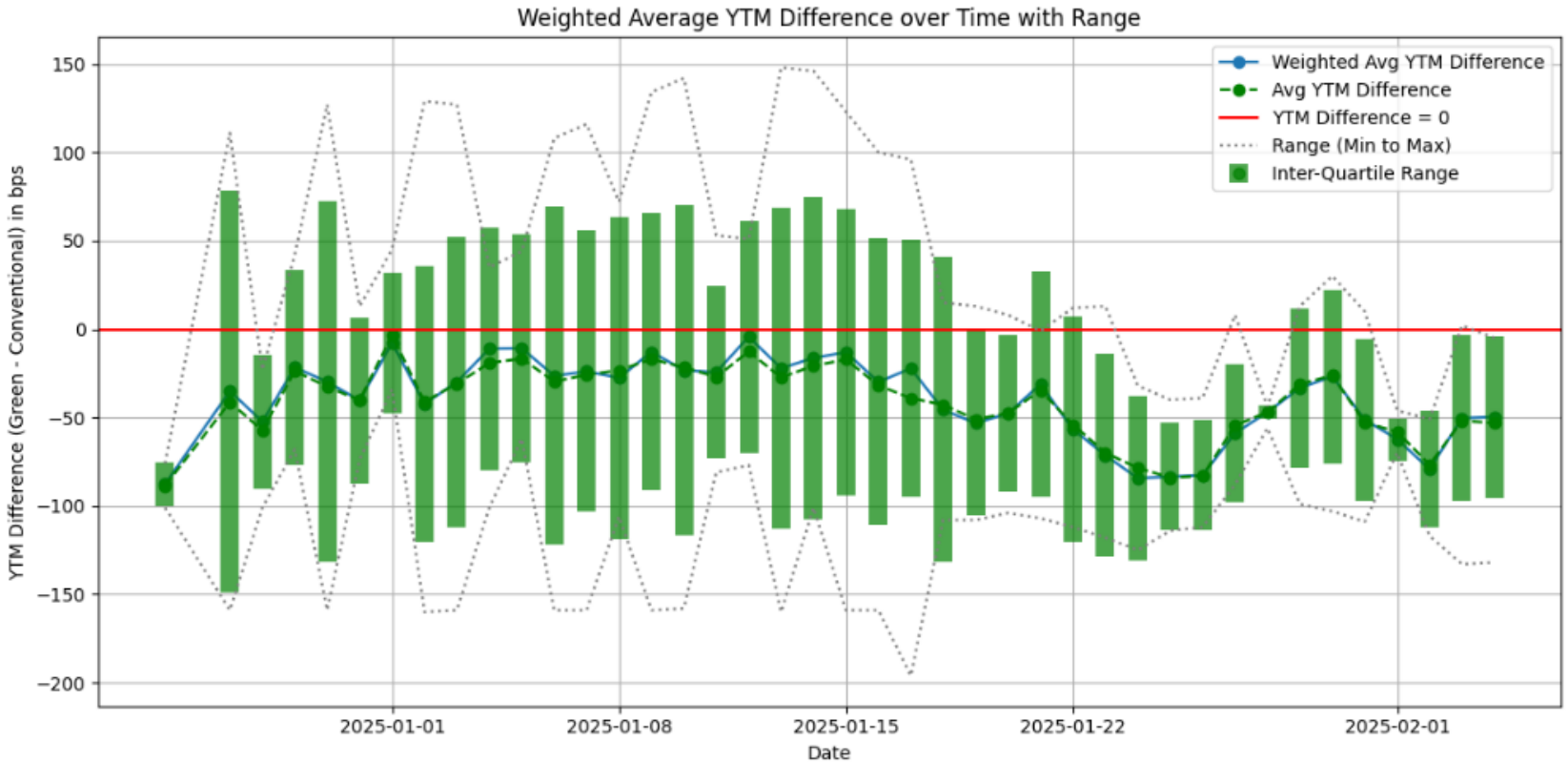


Figure: One-to-one matching

Matching Method Results

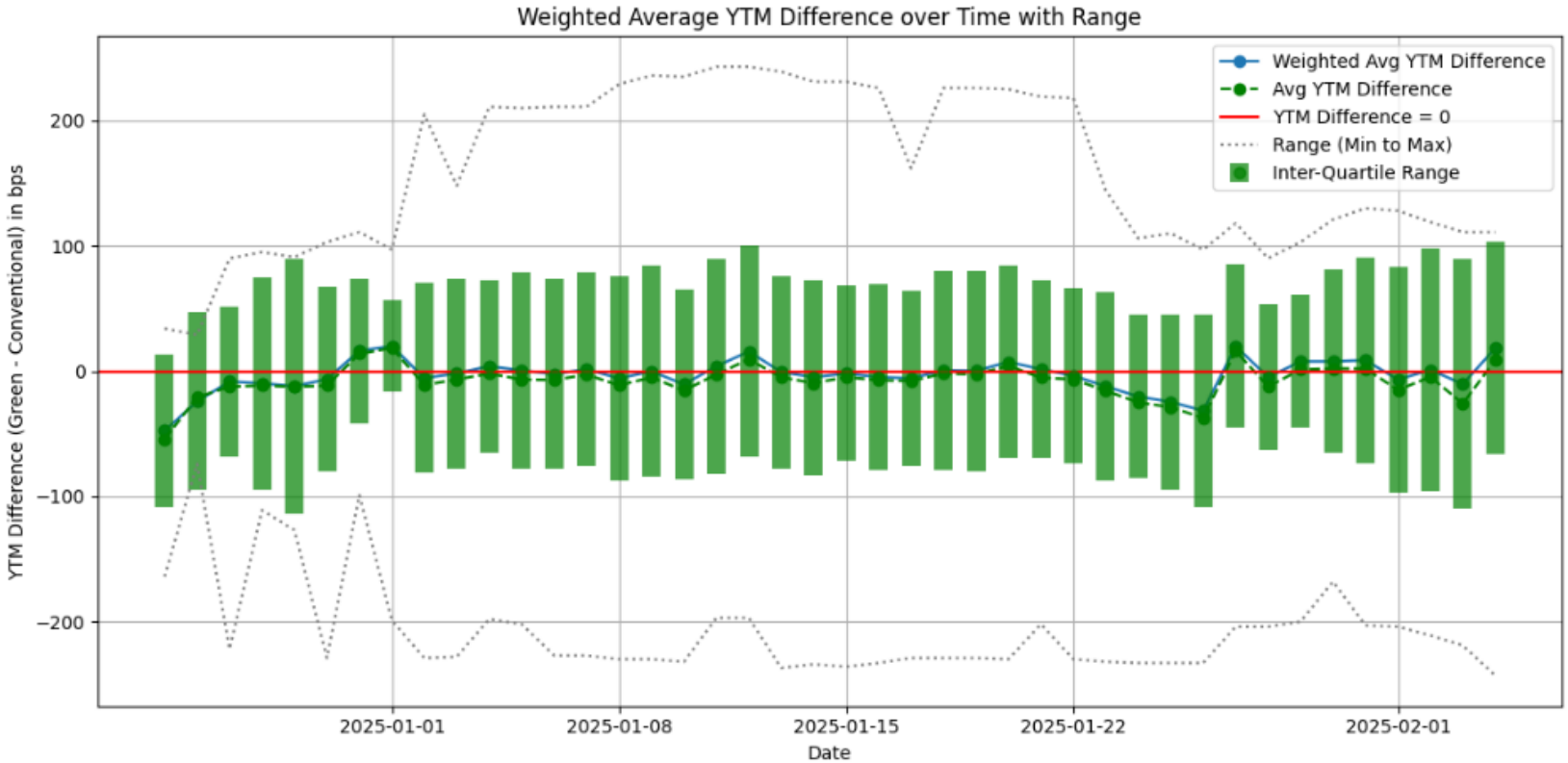


Figure: One-to-many matching

Matching Method Results

- **One-to-One Matching:** Negative yield differential of about -20 to -25 bps.
- **One-to-Many Matching:** Weaker signal with estimates closer to -3 to -8 bps.
- **Interpretation:** The matching design significantly impacts the estimated greenium.

Overview of Mean YTM Differences (Greenium Estimates)

Method	**Weighted Mean Greenium**	**Mean Greenium**
One-to-One Matching	-0.2014	-0.2521
Winsorized One-to-One Matching	-0.1636	0.1962
One-to-Many Matching	-0.0314	-0.0793

Note: Negative values indicate a greenium (i.e., lower YTM for green bonds compared to conventional ones).

Panel Regression Analysis

- **Model:**

$$YTM_{i,t} = \beta_0 + \beta_1 \, \text{is\_green}_{i,t} + X_{i,t}\gamma + M_t\delta + \varepsilon_{i,t}$$

- **Controls:** Days to maturity, coupon rate, modified duration, and macroeconomic factors (Euribor, Bund yield, VIX).
- **Finding:** The coefficient for `is_green` is approximately 0.0032 (0.32 bps) and not statistically significant.

Panel Regression Results

Variable	Specification (1)	Specification (2)
is green	–	0.0032
	–	(0.0344)
days to maturity	0.0001***	0.0001***
	(3.88e-05)	(4.087e-05)
modified duration	70.786***	70.606***
	(22.883)	(23.700)
log emissions volume	0.0365	0.0364
	(0.0255)	(0.0256)
Coupon	0.0296**	0.0296**
	(0.0123)	(0.0124)
Euribor 3m	0.3173***	0.3188***
	(0.0521)	(0.0506)
Bund 10yr	0.8685***	0.8682***
	(0.0345)	(0.0341)
VIX	-0.0004	-0.0004
	(0.0015)	(0.0015)

*Table: Comparison of panel regression specifications. Standard errors in parentheses. Significance: *** p¡0.01, ** p¡0.05.*

Nelson–Siegel–Svensson Approach

- **Objective:** Compare yield curve dynamics of green vs. conventional bonds.
- **Model Equation:**

$$y(\tau) = \beta_0 + \beta_1 \frac{1 - e^{-\lambda_1 \tau}}{\lambda_1 \tau} + \beta_2 \left(\frac{1 - e^{-\lambda_1 \tau}}{\lambda_1 \tau} - e^{-\lambda_1 \tau} \right)$$

$$+ \beta_3 \left(\frac{1 - e^{-\lambda_2 \tau}}{\lambda_2 \tau} - e^{-\lambda_2 \tau} \right)$$

- **Results:**
  - Negative greenium observed at intermediate maturities (2.5–10 years).
  - Yield curve differences align with matching and regression findings.

Nelson–Siegel–Svensson Visualisation

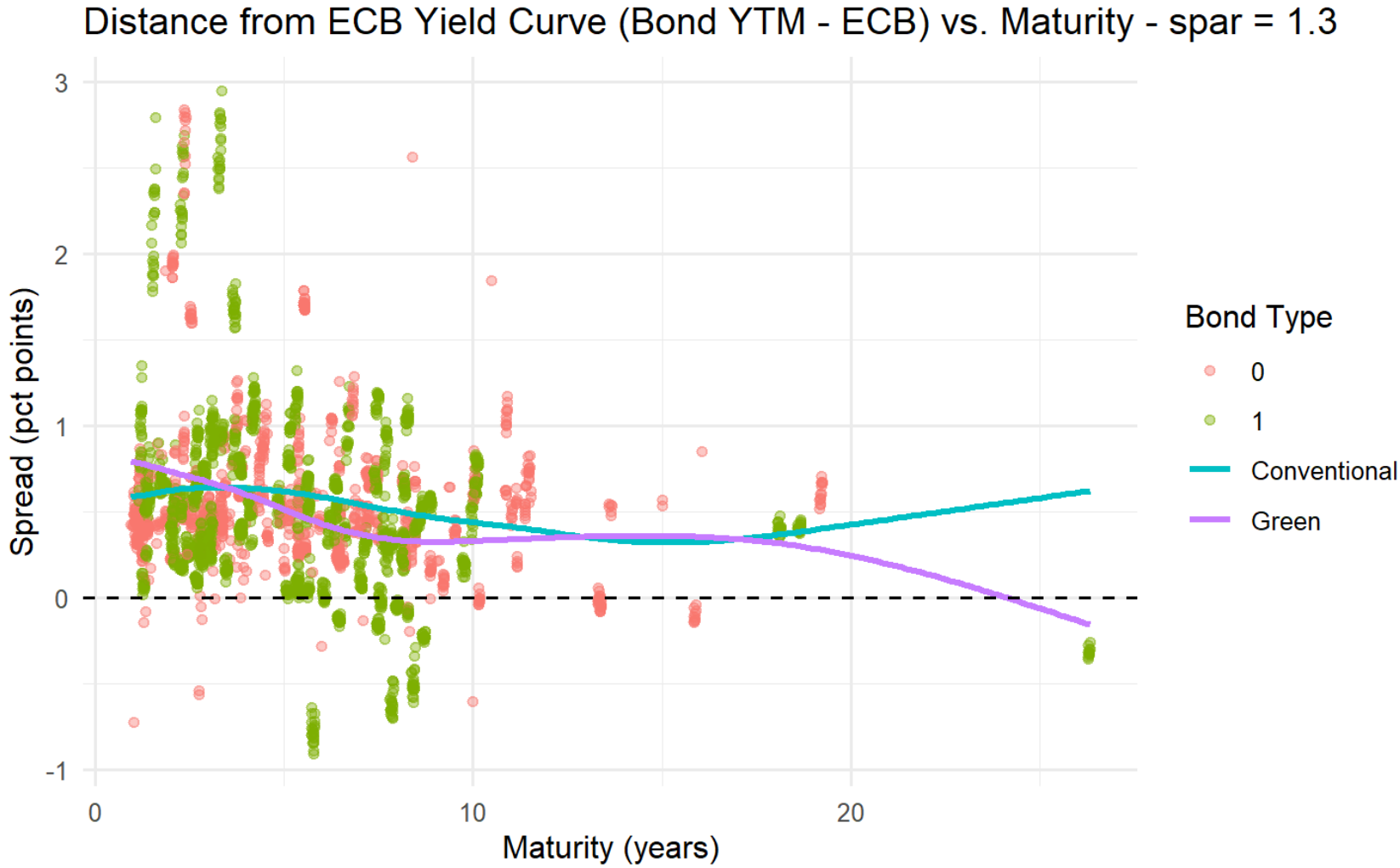
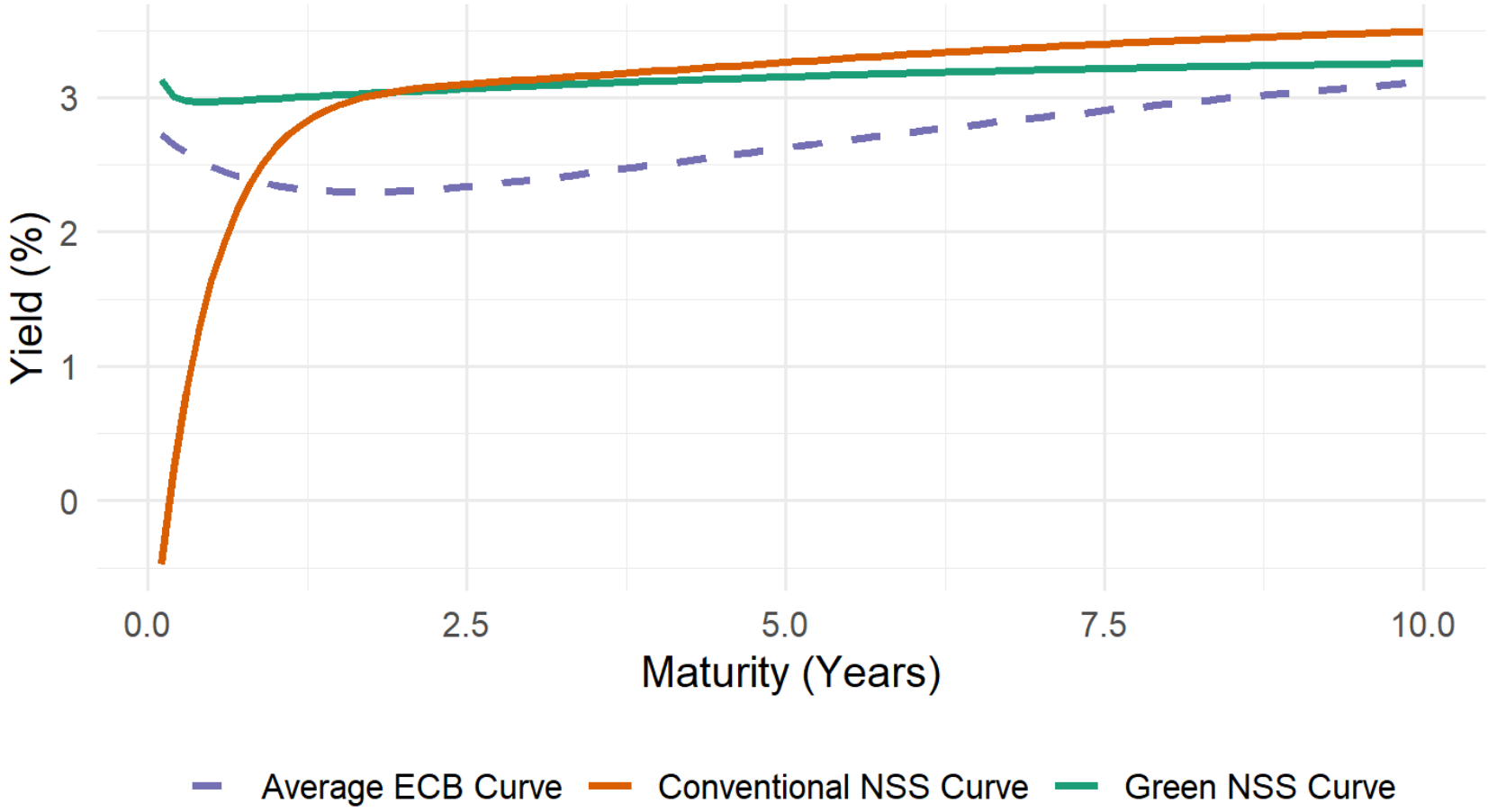


Figure: Fitted NSS yield curves – green vs. conventional bonds (ECB data)

Nelson–Siegel–Svensson Visualisation



Fitted NSS yield curves: Green Bonds Conventional and Bonds and ECB (ECB data)

Robustness Checks

- **Data Treatment:** Winsorizing and strict intra-day matching to reduce noise.
- **OLS on Matched Samples:** Reinforces the presence of a negative greenium.
- **Newey-West Adjusted t-Test:** Confirms the significance of the negative yield differential.

Methodological Trade-Offs

- **Matching Design:** One-to-one matching reveals a stronger greenium than one-to-many.
- **Issuer Heterogeneity:** Panel regression with fixed effects absorbs differences, reducing the greenium effect.
- **Takeaway:** Methodological choices critically influence greenium estimation.

Conclusion

- **Main Findings:**
  - A strict matching approach shows a negative greenium of roughly -20 bps.
  - Panel regressions suggest the greenium becomes negligible once issuer-specific factors are controlled for.
  - Yield curve analysis supports a modest, maturity-dependent greenium.
- **Implication:** The existence and magnitude of the greenium are sensitive to methodological design.

Extensions and Future Work

- Incorporate additional data on green bond certification.
- Integrate issuer-level CO_2 emissions to assess environmental impact.
- Explore sector-specific variations in the greenium.

Questions and Discussion

Questions?