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# Green versus conventional bonds during market stress: Threats to financial stability?

**Ewa Dziwok**, University of Economics in Katowice
**Paweł Kliber**, Poznan University of Economics and Business
**Niklas F. Wagner**, University of Passau

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# Agenda

1. Introduction – the problem that we address
2. Model
3. Empirical results
4. Conclusions

# The aim of the study

- the use of paired bonds - green and conventional securities issued by the same entities.
- to assess whether green bonds function as safe-haven assets or as transmitters of shocks.
- examining the connectedness between green and conventional bonds in the European market.

Motivation:

- existing research stands that green bonds' implications for financial stability remain not well-assessed.

# Literature review

- Empirical findings on how green bonds **behave during financial turmoil** are mixed. Green bonds may stabilize portfolios in calm periods (Chopra & Mehta, 2023; Kuang, 2021; Martiradonna et al., 2023) but transmit volatility when systemic risks increase, depending on sample design, model specification, and the definition of stress regimes (Wang et al., 2024; Shi & Guo 2025) .
- **Connectedness between green and conventional** fixed-income markets strenghten in crisis phases: Billah et al. (2023) for green and ethical Sukuk bonds; Contractor et al. (2023) for green and conventional bonds; Wang et al. (2025) for the Russia-Ukraine conflict.
- **Yield-curve based models** were applied to examine how green bond risks evolve across maturity through latent factors: level, slope, and curvature: Umar et al., 2022; Badics et al., (2023) highlight the influence of central bank actions; Cavaca and Meurer, (2021) from U.S. to South American curves.

# Three dimentions of research

- extracting latent factors **from paired bonds** offers a cleaner identification of the “green” factor in bond pricing and volatility.
- yield-curve-latent factor connectedness analysis of green versus conventional bonds is going beyond raw return comparisons to **capture dynamics across maturities**.
- findings are situated within the **debate on financial stability**, showing that while green bonds help finance the low-carbon transition, they appear to amplify volatility during crises.

# Methodology and steps

**data**

paired-bond prices from the Eurozone, issued by:
- the European Investment Bank (EIB),
- the German government, and
- German public banks

**YC factors**

Dynamic Nelson-Siegel (DNS) model (Diebold & Li, 2006), is applied to estimate three latent factors: level, slope, and curvature, on a daily basis for each bond in our dataset.

**TVP-VAR**

Bayesian time-varying parameter VAR model (TVP-VAR) is used (Primiceri, 2005), estimated via the Kalman filter with time-varying coefficients and stochastic volatility

**connectednes**

a) Static and dynamic full-sample connectedness
b) stress period no 1: Russia – Ukraine conflict
c) stress period no 2: Covid-19 pandemic

# Data: 11.05.2021 – 31.12.2024

(i) European Investment Bank conventional bonds (EIB)

(ii) European Investment Bank green bonds (EIB-G)

(iii) German government conventional bonds (DBB)

(iv) German government green bonds (DBB-G) – Green Federal Securities

(v) German public bank conventional bonds (GCB)

(vi) German public bank green bonds (GCB-G)

# Latent factors

We use the DNS model to extract three latent yield-curve factors (level, slope, and curvature) for each of the six bond types:

EIB, EIB-G, DBB, DBB-G, GCB, and GCB-G.

$$y_t(\tau) = \beta_{0,t} + \beta_{1,t}\left(\frac{1-e^{-\lambda\tau}}{\lambda\tau}\right) + \beta_{2,t}\left(\frac{1-e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right)$$

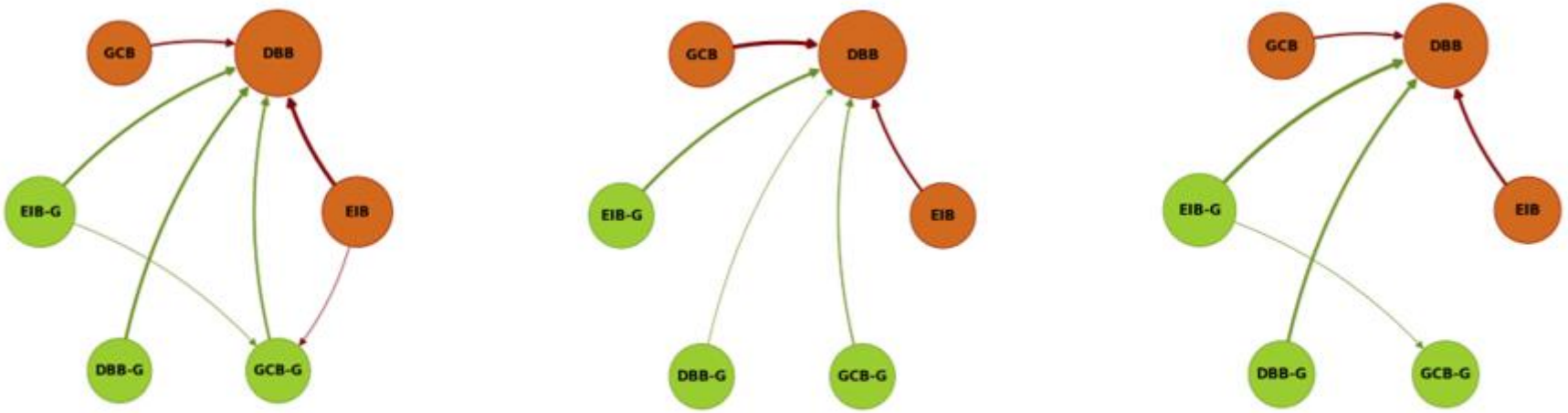
Where: $y_t(\tau)$ is the set of zero-coupon yields in each period $t$, $\tau$ denotes the maturity, and $\beta_{0,t}$, $\beta_{1,t}$, $\beta_{2,t}$ are time-varying parameters that explain the shape of the yield curve: the level, slope, and curvature respectively

# Static full-sample connectedness analysis

| Factor | Bond | EIB | DBB | GCB | EIB-G | DBB-G | GCB-G | FROM |
|---|---|---|---|---|---|---|---|---|
| | EIB | 24.26 | 5.84 | 14.36 | 21.92 | 18.39 | 15.24 | 75.74 |
| | DBB | 16.09 | 22.48 | 16.62 | 15.83 | 17.96 | 11.02 | 77.52 |
| | GCB | 16.00 | 11.07 | 25.75 | 15.93 | 19.16 | 12.09 | 74.25 |
| Level | EIB-G | 21.88 | 6.02 | 14.17 | 24.28 | 17.68 | 15.97 | 75.72 |
| | DBB-G | 18.68 | 8.46 | 17.92 | 18.01 | 24.66 | 12.27 | 75.34 |
| | GCB-G | 18.32 | 4.21 | 12.75 | 19.27 | 14.21 | 31.25 | 68.75 |
| | **TO** | 90.97 | 35.59 | 75.81 | 90.96 | 87.39 | 66.59 | 447.32 |
| | **NET** | 15.22 | -41.92 | 1.57 | 15.24 | 12.05 | -2.16 | |

The “TO” values (column) indicate the extent to which a bond category contributes to the forecast error variance of others, while “FROM” values (rows) show the proportion of a bond’s dynamics explained by external shocks from other bonds. The “NET” measure, calculated as the difference between TO and FROM, identifies whether a bond acts primarily as a transmitter or receiver within the system.

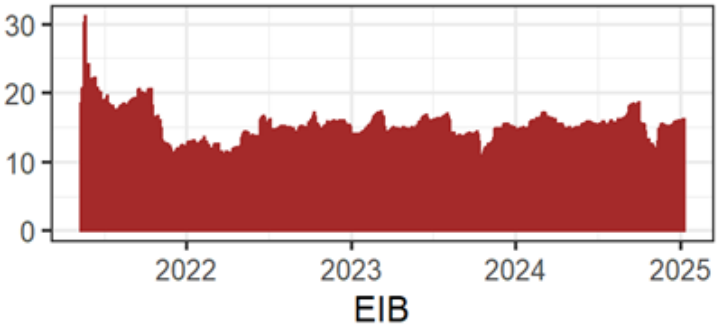
# Static full-sample connectedness analysis

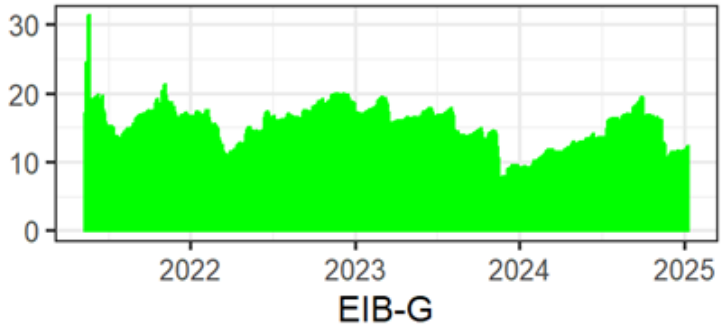


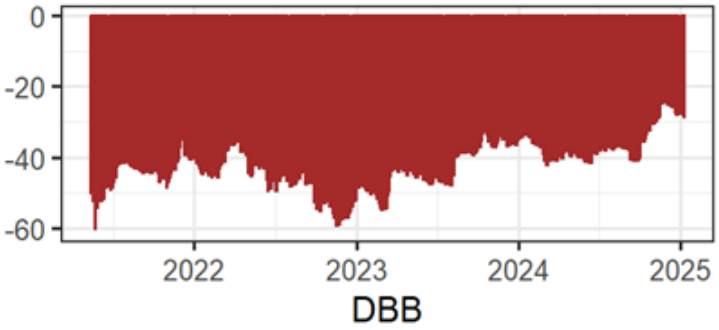

(a) Level (b) Slope (c) Curvature

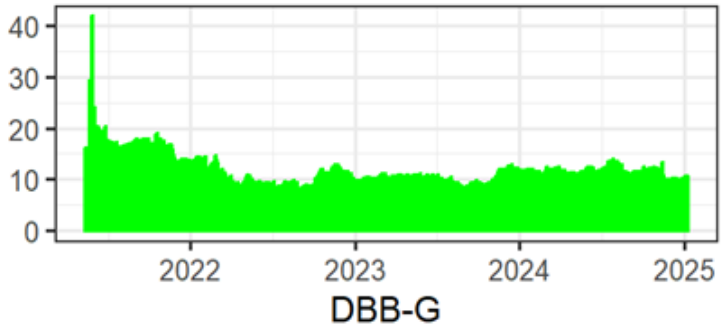
Arrows indicate the direction of spillover, from transmitter (tail) to receiver (head), with thickness reflecting spillover strength. Node size represents total bond's connectedness, with larger circles indicating stronger overall interaction (both transmitting and receiving). Green nodes denote green bonds (EIB-G, DBB-G, GCB-G), while brown nodes represent their conventional counterparts (EIB, DBB, GCB).

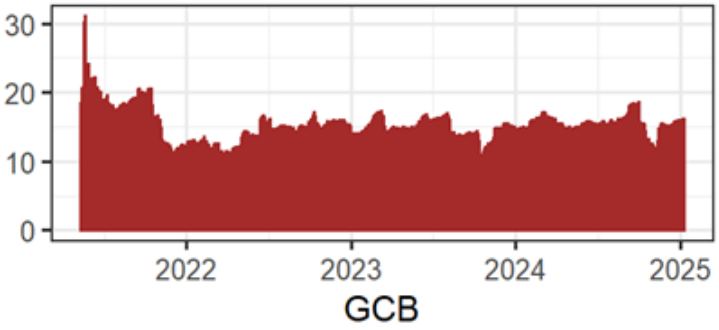
# Dynamic net directional connectedness (level)

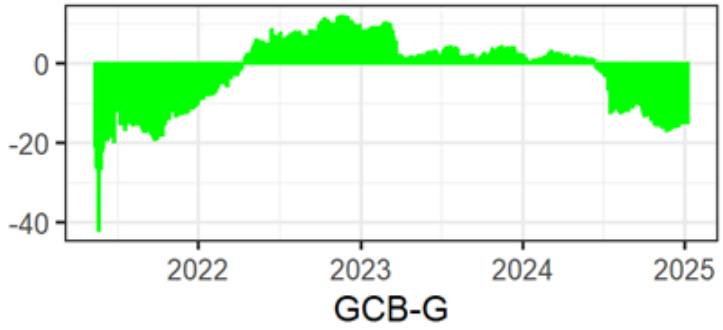


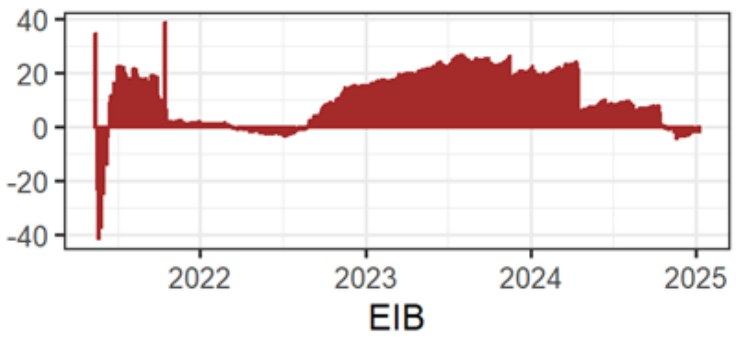



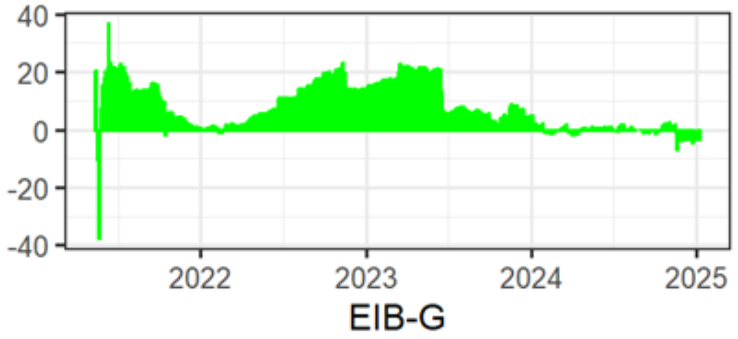



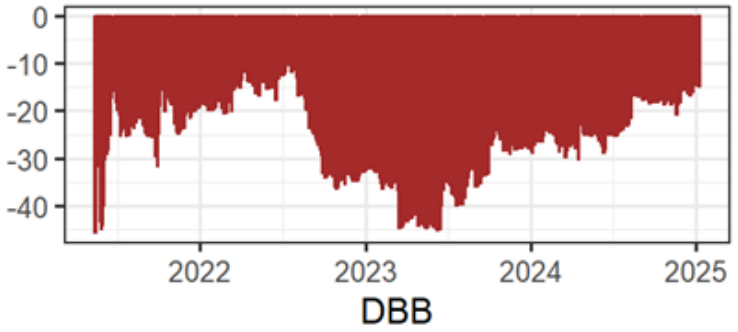



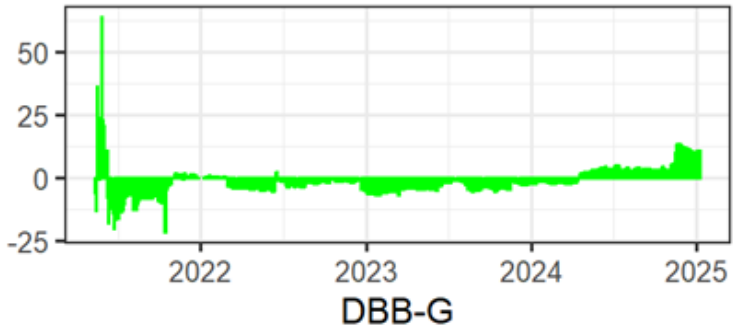



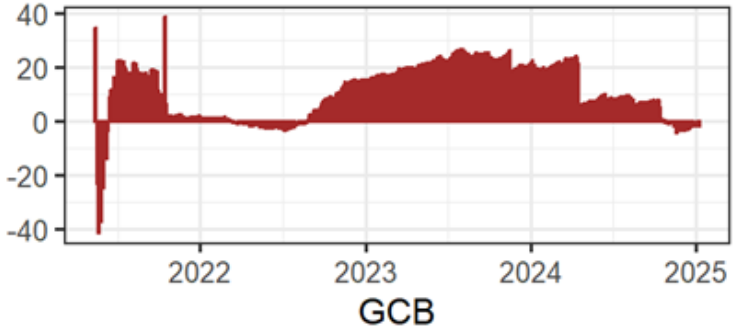
# Dynamic net directional connectedness (slope)

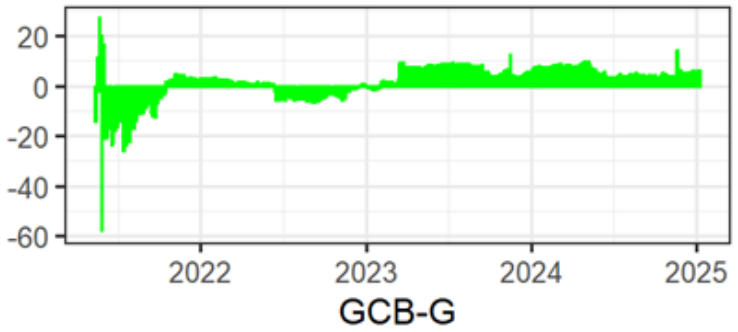


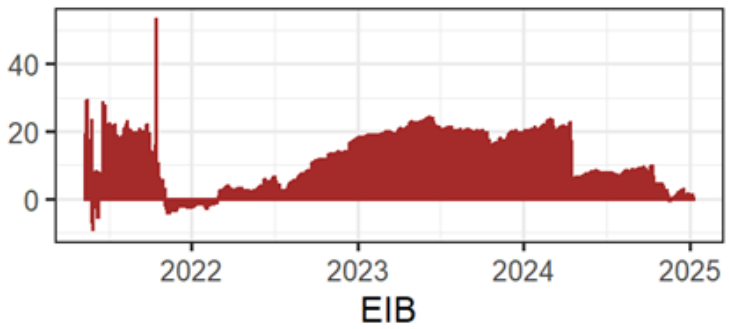



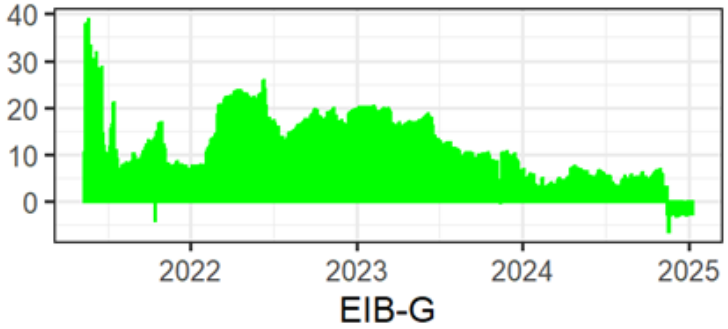



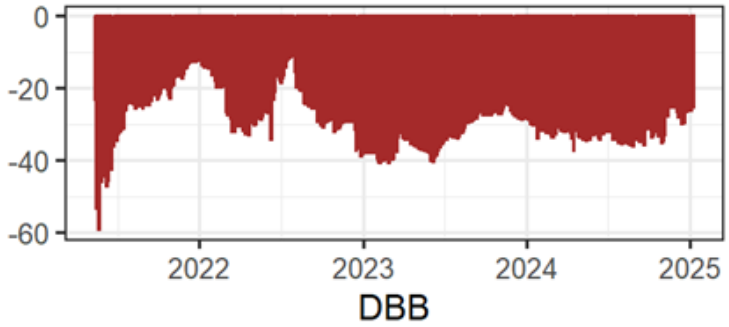



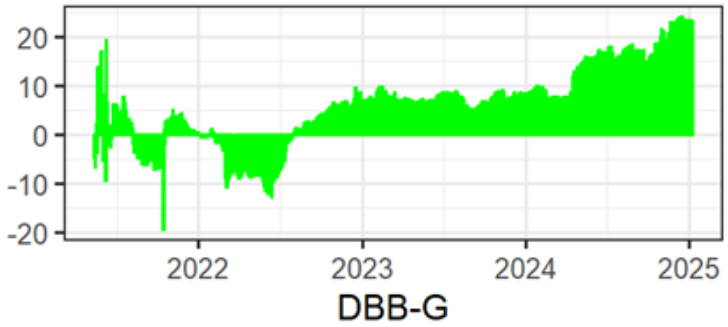



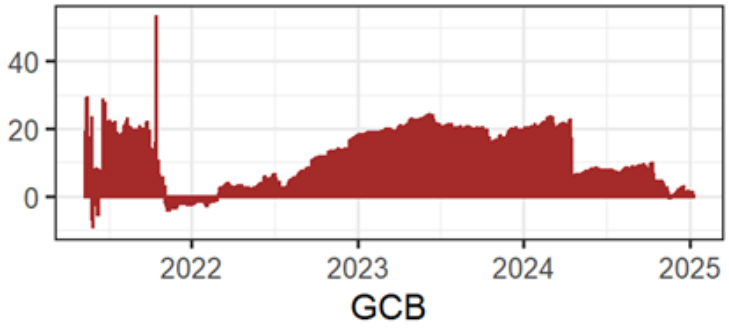
# Dynamic net directional connectedness (curv)

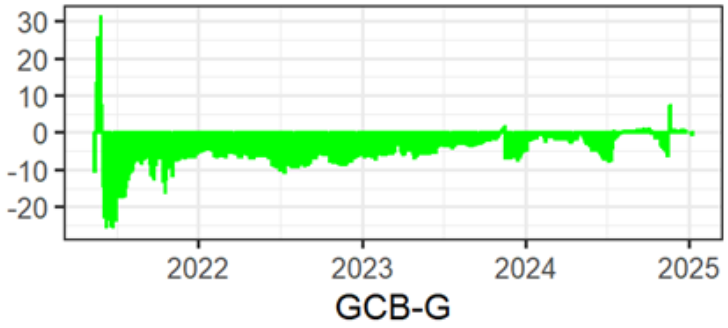


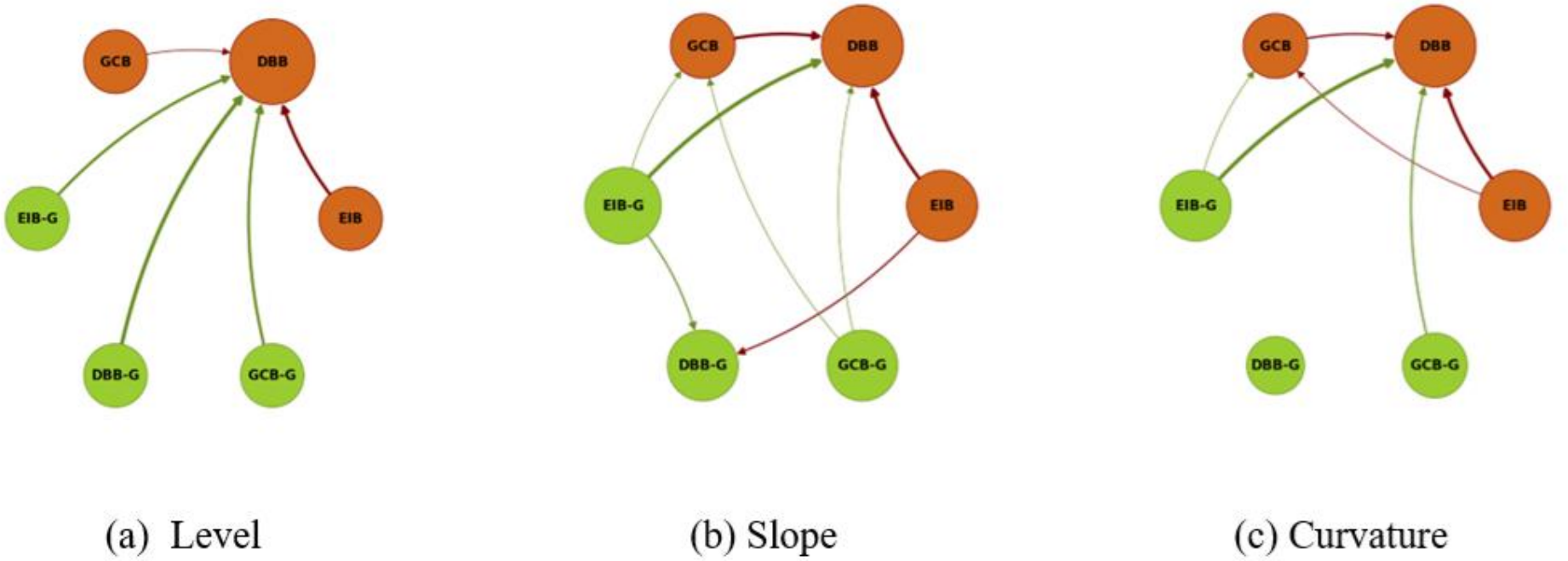



# Connectedness during the war in Ukraine

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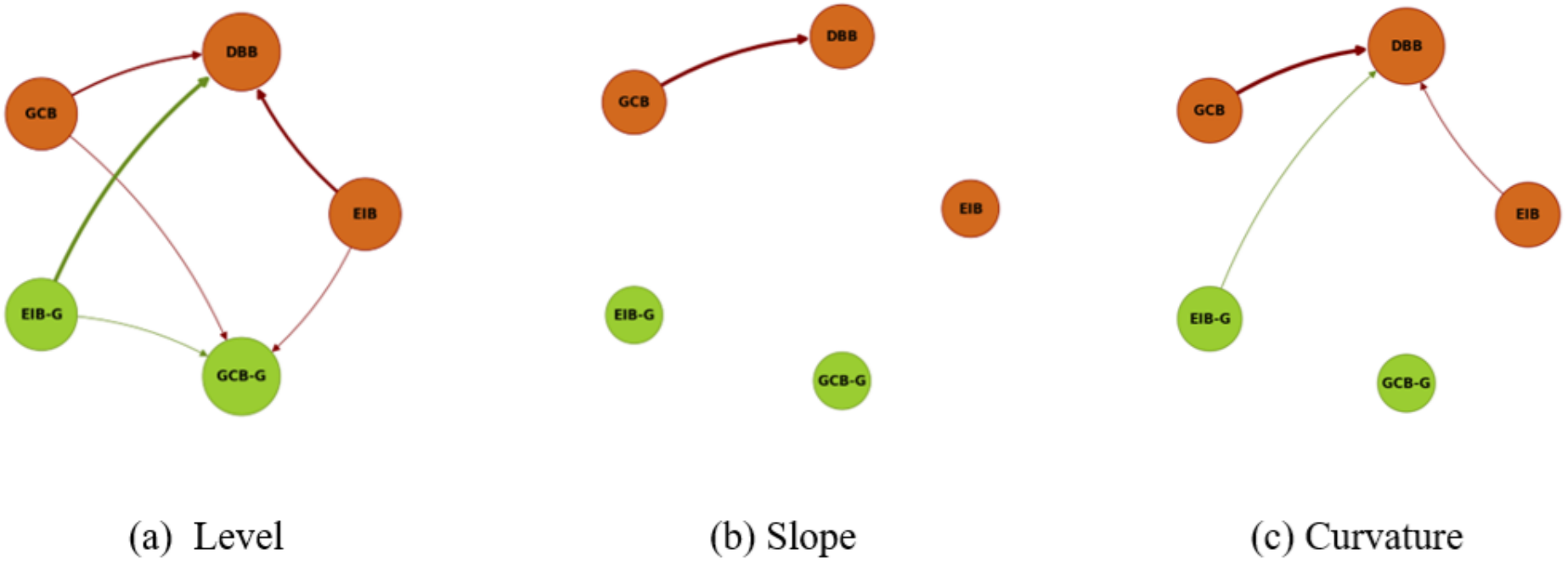
# Connectedness during the Covid-19

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# Conclusions

- German sovereign bonds (DBB) continue to play a stabilizing, safe-haven role.
- Green bonds (DBB-G, GCB-G) show increasing sensitivity to systemic events, especially during the Russia-Ukraine war.
- Green bonds including those issued by the German government, do not act as safe-haven assets during crises.
- Green bonds often act as transmitters of financial shocks.
- Green finance can serve as a driver of sustainable investment but also act as a channel through which economic and geopolitical shocks propagate across financial markets.

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# Thank you for your attention!

ewa.dziwok@ue.katowice.pl

University
of Economics
in Katowice

www.ue.katowice.pl