MEASURING MULTI-SCALE CONNECTEDNESS BETWEEN GREEN BOND AND GREEN EQUITY USING A THICK PEN METHOD

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The recent transition of energy, concerns for climate change and sustainability through environmental-friendly projects has increased the popularity of green investments among policymakers, investors and scholars. In particular, since the issuance of the first green bond by the European Investment Bank (EIB) in 2007, there has been significant growth in the green bond market. This increasing trend is often referred to as a 'green bond boom' (Morgan Stanley, 2017). Concurrently, there has been a significant shift in the equity market due to investors' interest in eco-friendly investments. Furthermore, financial investors started to focus on changing their portfolios due to fewer diversification benefits in equity markets that is triggered by Global Financial Crisis. It is important to investigate how green bonds and other green investments/assets are integrated. This is because the information on their co-movement can assist in allocating n optimal portfolio.

Our theoretical basis for the integration between green bonds and equity relies on the theoretical link between bonds and the conventional stock market as suggested by Dean, Faff, and Loudon (2010). Dean, Faff, and Loudon (2010) find asymmetry in return and volatility spillover between the traditional bond and stock market. Our empirical strategy is motivated by Pham (2021) and Chatziantoniou et al. (2021) who use cross–quantile dependence framework to investigate price connectedness between the green bond and green equity. While their model is based on a parametric approach, we use a non-parametric approach that is based on Thick Pen Transform (TPT) method.

We investigate return co-movement between the green bond and green equity using an approach called the 'Thick Pen Measure of Association (TPMA)' of Fryzlewicz and Oh (2011), which was later extended by Jach (2021) to 'Multi-thickness Thick Pen Measure of Association (MTTPMA)' to provide new insights on the changes in the co-movement dynamics. TPMA technique allows us to empirically examine co-dependencies between the green bond and equity for a given time scale or for a range of time scales, whereas the MTTPMA technique allows for the examination of codependencies across different time scales; that is, capturing a short-term component of a commodity futures series with long-term components of an equity index, or the other way around.

Methods

We follow a similar data series as Pham (2021), where S&P Dow Jones green bond index is a proxy for the green bond market and NASDAQ OMX green economy stock index (Clean energy, green building, green transportation and global water). Apart from that we also include Bloomberg Barclays MSCI green bond index and the Solactive green bond index to verify whether the relationship changes varying the green bond index.

We follow Fryzlewicz and Oh (2011) and Jach (2021) to measure co-movements between the variables. We use a bivariate model. We calculate the Thick Pen Measure of Association (TPMA) of Fryzlewicz and Oh (2011) using;[1]

$$\rho_t^\tau\left(X^{(1)}, X^{(2)}, \dots, X^{(K)}\right) = \frac{min_k\left(U_t^\tau\left(X^{(K)}\right)\right) - \max_k\left(L_t^\tau\left(X^{(K)}\right)\right)}{max_k\left(U_t^\tau(X^{(K)})\right) - \min_k\left(L_t^\tau(X^{(K)})\right)} \tag{1}$$

where, $X = (X_t)_{t=1}^{\tau}$ represents the time series of daily log returns; K = 2 which represents a single green bond index and a single green equity index; τ_i is the positive thickness parameter (scaler superscript) i.e. τ = 22 is month 1 data, τ = 126 is month 6 data and τ = 252 is year 1 data. We follow $L_t^\tau = \min(X_t, X_{t-1}, \dots, X_{t-\tau})$ shows lower boundaries of thickness and $U_t^\tau = \max(X_t, X_{t-1}, \dots, X_{t-\tau})$ shows upper boundaries of thickness. The thick pen transform of X is denoted as follows

$$TP_{\tau_i}(X) = \{(L_t^{\tau_i}(X)U_t^{\tau_i}(X))_{t=1}^T\}_{i=1}^n$$

[1] see Jach (2021) for details of the model.

We calculate the multi-thickness Thick Pen Measure of Association (MTTPMA) of Fryzlewicz and Oh (2011) using;

$$\rho_t^{(\tau^{(1)},\tau^{(2)},\dots,\tau^{(K)})}\left(X^{(1)},X^{(2)},\dots,X^{(K)}\right)=\frac{min_k\left(U_t^{\tau^{(K)}}\left(X^{(K)}\right)\right)-\max_k\left(L_t^{\tau^{(K)}}\left(X^{(K)}\right)\right)}{max_k\left(U_t^{\tau^{(K)}}\left(X^{(K)}\right)\right)-\min_k\left(L_t^{\tau^{(K)}}\left(X^{(K)}\right)\right)} \qquad (2)$$

where scaler τ of Equation 1 is replaced by vector τ in Equation 2.

Results

The preliminary result suggests that there is an overall mixed association between green bond and green equity index in the long run than in the short run. However, this association varies because of some financial events and due to the type of green equity sub-index. Since the financial downturn in 2020 because of the Covid pandemic 19 periods, the overlaps between the green bond index and green equity index are low. In the long-term time scale, we find weak co-movement between the green bond index and clean focused energy index. This shows that issuing a green bond with long-term maturity will encourage clean focused energy index investors to invest in green bonds. On the other hand, the overlaps between the green bond index and the green transportation index are higher in the long run. This suggests investing in the green bond will not be beneficial for investors in green transportation in the long term. We also find some asymmetry in return co-movement between the green bond and green equity in multi-scale connectedness (MTTPMA). In the majority of cases, the results show that in short term (i.e. in higher frequencies) co-movements are lower than in the longer term (i.e. in lesser frequencies) co-movement. However, these results vary in extremely volatile periods. We find similar results to Chatziantoniou et al. (2021), that the short term and long term co-movement do not co-move synchronously, rather it varies depending on financial and economic events.

Conclusions

The results provide new insights into the interdependence between the green bond index and green equity index uncovering some asymmetric effects of the short-term and long-term features of co-movement similar to the findings of Dean, Faff, and Loudon (2010). This technique is beneficial for diversifying the portfolio by combining green bonds and green equity (depending on sub-indices) in the short term and the long term. These results are beneficial for both short-term and long-term policy perspectives. Future research may divide the green bond index into sub-sectors to know which sub-sector co-moves with green investment and which does not.

References

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