

DYNAMIC CORRELATION AND VOLATILITY SPILLOVER AMONG GREEN BONDS, CLEAN ENERGY STOCK, AND FOSSIL FUEL MARKET.

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Overview

For mitigating environmental degradation caused by climate change, investing in green bonds (GB) is becoming of great interest to not only environmentally conscious investors but also energy policymakers (Reboredo and Ugolini, 2020). As the scale of investment in GB grows rapidly, understanding how the GB market is related to renewable energy stock and fossil fuel market is essential for energy investors and policymakers to identify the importance of the GB market relative to clean energy (CE) and fossil fuel market. Besides, understanding how volatility spillover between them may help policymakers deal with the price volatility risk for developing the GB market to achieve sustainable economic development.

Thus, the goal of our research is to examine how the GB market is related to CE stock and fossil fuel markets (coal, WTI, natural gas (NG), heating oil (HO), and gasoline) simultaneously. Further, we study how the volatility spillover effects between them are changing in the short-term, medium-term, and long-term horizons. To this end, the US markets were chosen since the US markets remained the largest source of green debt with a total of USD 52.1 bn (18%) and the world's largest energy and financial trading markets which means that the US market can better reflect the GB co-movements with CE stock and fossil fuel markets. For crude oil, we also included the Brent market to identify if there is a difference in the impact between the WTI and Brent crude oil on the GB market.

Methods

First, we follow the Bayesian DCC-MGARCH model framework of Tang and Aruga (2022) to analyze the correlation among the GB, CE, and fossil fuel markets as it is known that the Bayesian DCC-MGARCH model is flexible for capturing the dynamic correlation between the fossil fuel and financial markets. Second, we applied the frequent domain spillover approach of Baruník and Křehlík (2018) which overcomes the hypothesis that the same preferences, anticipations, expectations, and risk aversion of the market are the same. The method analyses the spillover or the recipient of price volatility among the GB, CE, and fossil fuels and tests how the volatility spillover is changing in the short-, medium-, and long-term investment horizons. The net spillover is the variance transmission from another market to one market that is a net giver and receiver of variance to and from all other markets when the net spillover effect is positive or negative.

Results

The result suggested that the GB has a weakly negative correlation (0 to -0.2) with the CE stock market, meaning that the CE stock market tends to rise when bond yields fall, and tend to slump when GB yields rise. The result also indicated that a negative or weak positive correlation (less than 0.4) existed between the GB and CE stock versus the fossil fuel markets. The volatility spillover among the GB, CE, and fossil fuel markets was the strongest in the short term but gradually weakened from the medium term to the long term (Table 1). The GB was a net volatility receiver from the WTI market, HO, and gasoline for the long- and medium-term (Table 1), indicating that investors holding GB assets should pay attention to the effect of WTI price volatility for managing risk involved in price change. The result for the volatility spillover also revealed that the WTI has a stronger relationship with the GB and CE than the Brent crude oil. A possible reason for this difference in the impact on the GB and CE between the WTI and Brent is that obviously the WTI is the US crude oil price while the Brent crude oil is a benchmark price for the European crude oil market (Aruga, 2015), and hence, the US GB and CE prices are more likely connected to the WTI price. Meanwhile, the volatility spillover from WTI to GB and CE was higher in the short-term compared to medium-, and long-term, gradually reducing in the medium term, disappearing in the long term (Table 1).

Table 1: The total and net spillover at short-, medium-, and long-term

		From ←←									
Short-term		GB	CE	Coal	WTI	Brent	NG	HO	Gasoline	Total	Net spillover
To ↓ ↓	GB	69.7	0.94	0.41	2.24	0.01	0.1	0.98	0.34	0.73	-0.388
	CE	0.41	62.9	0.67	6.27	0.06	0.25	7.05	7.48	3.24	-0.934
	Coal	0.3	0.64	77.2	0.49	0.22	0.13	2.15	0.44	0.64	-0.172
	WTI	0.31	4.14	0.27	40.3	0.07	0.47	25	18.99	7.18	0.719
	Brent	0.04	0.12	0.05	0.08	88.67	0.3	0.05	0.08	0.11	-0.027
	NG	0.23	0.32	0.31	1.57	0.04	82.9	1.68	1.51	0.83	-0.396
	HO	0.04	4.15	1.04	24.5	0.06	0.69	38.6	19.05	7.23	0.955
	Gasoline	0.58	4.41	0.24	19.8	0.04	0.54	20.5	42.06	6.75	0.203
	To total	0.28	2.15	0.44	8.02	0.07	0.36	8.39	6.99	26.7	/
Medium-term		GB	CE	Coal	WTI	Brent	NG	HO	Gasoline	Total	Net spillover
To ↓ ↓	GB	20.2	0.79	0.02	0.73	0.01	0.01	0.36	0.02	1.94	-0.160
	CE	0.12	9.84	0.02	0.92	0.03	0.05	1.09	0.93	3.15	0.041
	Coal	0.18	0.31	14.5	0.1	0.01	0.02	0.86	0.1	1.57	-0.129
	WTI	0.06	0.63	0.05	3.72	0	0.03	2.57	2.07	5.4	0.175
	Brent	0	0.02	0.02	0	9.2	0.04	0	0	0.09	-0.003
	NG	0	0.04	0.15	0.08	0.01	9.36	0.28	0.12	0.68	-0.056
	HO	0	0.77	0.23	2.68	0.01	0.04	4.48	2.14	5.86	0.185
	Gasoline	0.29	0.93	0.05	2.3	0	0.04	2.19	4.41	5.78	-0.052
	To total	0.66	3.48	0.54	6.79	0.07	0.24	7.33	5.37	24.48	/
Long-term		GB	CE	Coal	WTI	Brent	NG	HO	Gasoline	Total	Net spillover
To ↓ ↓	GB	2.8	0.12	0	0.1	0	0	0.05	0	1.93	-0.023
	CE	0.02	1.44	0	0.13	0	0.01	0.16	0.14	3.22	0.008
	Coal	0.03	0.05	2.12	0.01	0	0	0.13	0.01	1.68	-0.021
	WTI	0.01	0.09	0.01	0.52	0	0	0.36	0.3	5.39	0.026
	Brent	0	0	0	0	1.3	0.01	0	0	0.09	0.000
	NG	0	0.01	0.02	0.01	0	1.32	0.04	0.02	0.72	-0.009
	HO	0	0.11	0.03	0.38	0	0.01	0.64	0.31	5.85	0.028
	Gasoline	0.04	0.14	0.01	0.34	0	0.01	0.32	0.63	5.97	-0.010
	To total	0.67	3.67	0.53	6.84	0.06	0.23	7.45	5.41	24.85	/

Conclusions

Our findings can offer some valuable implications for investors and energy policymakers. First, the GB has a weakly negative correlation or no correlation with the CE and fossil fuel, suggesting that the GB market is independent of the CE and fossil fuel markets. This information can tell investors or policymakers that the GB market does not yet have much influence on the CE and the fossil fuel markets. Second, given that the GB and CE are net volatility receivers from the WTI, HO, and gasoline markets in the short term, it is important for across market investors to consider the effects of risk spillover from the fossil fuel market to GB and CE markets. Finally, given that the correlation and volatility spillover of WTI to GB and CE are stronger than that of Brent to GB and CE in the short term, the stakeholders to develop GB market should note that the spillover effect of WTI price is different from the Brent price.

References

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