**Abstract**: This study analyzes the effect of environmental, social, and governance (ESG) performance on key macroeconomic factors in Montenegro. Using data from January 2006 to December 2017, we measure dynamic volatility spillover and network connectedness due to shocks to (a) environmental, (b) social, and (c) governance. Contrary to assumptions, greenhouse gas (GHG) emissions de-anchor investor expectations, disrupt markets and destabilize key macroeconomic factors. Our novel findings indicate that sustainable growth should not be based only on a traditional energy assumption and reveal the mechanism of key gaps by a prudential authority.

Keywords: ESG, Connectedness, Forecast, Macroeconometrics, Policy objective

JEL classifications: O14, C5, E17, E61

# **Introduction**

Social, environmental, and governance disparities are urgent problems for our society, with implications for a range of outcomes from economic growth and political stability to crime, public health, family well-being, and social trust. There are strong political, societal, demographic, and economic reasons for policymakers to examine and reveal the multi-scale determining macroprudential factors and promote inclusive growth. Revealing the dynamic volatility spillover and network connectedness of ESG factors remains one of the most significant and urgent challenges facing policymakers today. This is the main objective of this study.

Socioeconomic and environmental issues such as racial disparities, the economic and political power of the richest 1 percent, the persistent underrepresentation of women at high levels, the economic hardships experienced by women of color and transgender individuals, gender discrimination and sexual harassment, changes in tax policies, global average temperature, health, tobacco and alcohol consumption, public trust, voter turnout, crime, and life satisfaction are severe social, environmental. and economic illnesses with a devastating impact on personal and social cohesion, affecting billions of people worldwide (Umar et al, 2020). These factors have been a key driver of the world’s skyrocketing inability to absorb shocks, such as the 2008 Global Financial Crisis, the COVID-19 pandemic, and the 2022 debt and inflation crisis, posing an immense risk to socioeconomic systems and democracy in the EU (not to mention small countries like Montenegro; Bojaj et al., 2022).[[1]](#footnote-2)

Previous studies have relied on the relationships among the general ESG indices and thus could not disentangle the specific country-level macroeconomic connectedness of ESG from general ESG effects. One set of research literature compares the performance of ESG-screened mutual funds to that of their conventional counterparts or benchmarks.[[2]](#footnote-3) Another stream of work examines how environmental, social, and governance transparency affects corporate value. Joliet and Titova (2018), Prasad et al., (2022), and Zhang and Zhang (2022) demonstrate that ESG efforts and disclosure boost business value. Another well-documented area of research is the performance of SRI in portfolios.[[3]](#footnote-4)

There is little research regarding the connectedness of ESG. Pham and Cepni (2022) study the [spillovers](https://www.sciencedirect.com/topics/economics-econometrics-and-finance/spillover-effect) between investor attention and green bond performance across normal and extreme market conditions, and find that these spillovers are time-varying, asymmetric, and significantly influenced by stock, oil, and bond market volatility, and [economic policy uncertainty](https://www.sciencedirect.com/topics/economics-econometrics-and-finance/economic-policy-uncertainty). They also find that the contagion has been more pronounced after the onset of the COVID-19 pandemic. Reboredo and Ugolini (2020)  study the price connectedness between the green bond and financial markets and reveal that the green bond market is a net price-spillover receiver. Ren et al., (2022) study the relationship between European Climate Exchange EU allowances for carbon futures prices and the Standard and Poor’s 500 green bonds index. They find that the carbon price has an asymmetric influence on the green bonds index, revealed by quantile-on-quantile regression, and that this influence is mostly positive.

The overarching goal of this study is the creation of a multiple spatio-temporal diagnostic model (“brain profiling”) that could provide policymakers with a look-up avenue to map out assessments, magnitudes, and risks even before the onset of an ESG shock, optimizing forecastings and policy-making efficiency. Motivated by the fact that ESG is an urgent priority for global authorities, the introduction of the 2030 Agenda by the United Nations in 2015, and the fact that Montenegro has since shown a commitment to achieving the related Sustainable Development Goals (SDGs), while also negotiating full membership in the EU since June 2012 (Bojaj et al., 2023), we seek to answer the following questions: (a) Are there spillover effects across the three sets of variables? (b) Which variables are the main transmitters/receivers *to* and *from* other variables? (c) What economic sectors seem to be most profitable? In order to address all of the above, our model focuses largely on SDG 9. SDG 9 (create a resilient infrastructure, encourage sustainable industrialization, and stimulate innovation) supports employment and income creation by developing new technologies, promoting international trade, and encouraging resource efficiency (Bojaj et al., 2023). Our findings will also be appealing to the EU macroprudential policymakers, the European Central Bank, and the government of Montenegro.

This study’s key novelty is threefold. Firstly, we add depth to the work of Diebold and Yilmaz (2014) by using a structural Bayesian vector autoregression (BVAR) model and spillover connectedness measures to forecast and assess how exogenous shocks to environmental, social, and governance factors affect the real economy. Second, we add breadth by combining for the first time, to the best of our knowledge, specific set variables of environmental, social, governance, and key macroeconomic factors. Third, we identify specific risk factors that could potentially act as mechanisms that transmit destabilization. The study fills the knowledge vacuum, combining theory and empirical analysis to contribute to the existing literature and empirical measurements of ESG interconnectedness and spillover effects. We provide clear economic intuitions and measurements of potential shocks under normal and extreme time-varying situations. We contribute to forecasting average and extreme ESG shocks and their macroeconomic connectedness volatility measures, employing a BVAR model that combines inherent-systemic and systematic-market vulnerability.

# **Data and Methodology**

* 1. *Data*

The National Sustainable Development Strategy (NSDS) is Montenegro’s long-term, horizontal, umbrella development strategy. It covers the long-term development of the environment, the economy, human resources, social capital, and financing and governance systems. We use this strategy as a basis to revise the macro-econometric model of the production function to include ESG factors, as shown in Equation (1), with a description of the variables provided in Table 1.

**Table 1: Description of variables**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Description** | **Source** |
|  | Gross domestic growth—H.P. filtered gap |  |
|  | Natural logarithm of government effectiveness |  |
|  | Natural logarithm of energy |  |
|  | Natural logarithm of agriculture and land |  |
|  | Natural logarithm of industrial processes |  |
|  | Natural logarithm of waste |  |
|  | Natural logarithm of credit |  |
|  | Natural logarithm of renewable energy |  |
|  |  |  |

*Note:* The variables used in the SVAR model are gross domestic growth; H.P. filtered gap; natural logarithm of government effectiveness; natural logarithm of energy; natural logarithm of agriculture and land; natural logarithm of industrial processes; natural logarithm of waste; natural logarithm of credit; and natural logarithm of renewable energy.

* 1. *Methodology*

We aim to obtain empirical findings from the structural vector autoregression (SVAR) model. We use this model because it captures Montenegro’s unique characteristics as a small, euroized economy.

  (1)

.

Matrix is defined as

*Note:*  is a vector of endogenous variables. Matrix is invertible and has coefficients of contemporaneous relations on the endogenous variables. are matrices capturing the dynamics of variables, and is a structural shock vector. The signs on are chosen to enable each equation to be written in regression form. We use the classic relationships among assessments of estimated errors and structural shocks. Bojaj et al., (2022) emphasize that in the case of VAR, the stability condition requires that coefficient . The condition that guarantees stability is that has eigenvalues smaller than 1 in modulus and is a prevalent and valid result for any VAR(p).[[4]](#footnote-5)

Using the same relation between the forecast errors and structural shocks, we define:

*Note*: denotes the matrix of endogenous variables, denotes a constant, is the variance-covariance matrix (). denotes structural shocks, and denotes the matrix of coefficients.

We continue applying variance decomposition to measure connectedness as central risk measurement and management. Our method for determining connectedness is based on Diebold and Yilmaz’s (2014) unified framework concept of connectedness. The forecast error variance of a variable is broken into its attributable constituent parts. Table 2 shows the conceptual framework of the connectedness and relationship measures.

**Table 2: Spillover (connectedness) table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | … |  | From others |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| To others |  |  |  |  |  |
|  |  |  |  |  |  |

*Note*: By definition, the numbers across a row will add up to 100; for example, in the first row, . The “From others” sum denotes the value that comes from other shocks and is not attributable to “own” shocks. The sum, for example, of the row “To others,” , denotes the shocks transmitted to other target variables. The “From others” column and the “To others” row sum to the same value, denoted by , . Therefore, except for pairwise directional connectedness, from to , , the off-diagonal total directional connectedness labeled “from” others to is , ; total directional connectedness “to” others from is ; and the total connectedness is . denote the set of variables, and we examine their connectedness. denotes the cross-variance decomposition of the th – forecast horizon step. This is the result of Cholesky shocks from a reduced set. A target variable is represented by a row, and a source shock is represented by a column. The above variance decomposition matrix is important for individuals, businesses, institutions, and the EU since it helps clarify one-to-one connectedness (e.g., energy-to-credit connectedness, aggregate macroeconomic connectedness, or total connectedness from others to output growth). Variance connectedness matrix measures can help various agents clearly understand the micro and macro aspects of market risks. For example, a financial institution company might be interested in understanding how output industrial processes, waste, and renewable energy are connected to it. By contrast, the EU might be interested in identifying the total ESG connectedness to others.

We use a new Keynesian macroeconomic model, and the neoclassical production function is used to estimate GDP growth, as in Roeger & Veld (2004). Following Giordani (2004), we apply the output gap since the output level is irrelevant. The method described above has not been used in Montenegrin data analysis. We use multiple hypothetical scenarios (e.g., decreases in Energy and Agriculture & land) because policymakers may be interested in understanding how GDP reacts under different conditions. We design hypothetical shocks, each simultaneously affecting the other, and assess the reaction of macroeconomic growth to ESG.

# **Results**

* 1. *Comparison of forecasts using VAR and BVAR*

We start with a comparison of forecasting performance using standard VAR and BVAR. This is shown in Table 3. Based on RMSE, BVAR shows an improvement over VAR in the accuracy of forecasts. The RMSE from the standard VAR is 0.79, while that of BVAR Independent Normal-Wishart figures is 0.19. We therefore concluded that the best model for GDP and all other variables forecasting: a significant input to policy decisions is the BVAR of the Independent normal-flat prior.

**Table 3: Comparison of forecasting performance using VAR and BVAR**

|  |  |  |
| --- | --- | --- |
| **VAR and BVAR** | **Variable** | **RMSE** |
|
| Standard VAR | GDP\_GAP |  |
| Priors | Minnesota | GDP\_GAP |  |
| Normal-flat | GDP\_GAP |  |
| Normal-Wishart | GDP\_GAP |  |
| Sims-Zha (Normal-Wishart) | GDP\_GAP |  |
| Independent Normal-Wishart | GDP\_GAP |  |

*Note:* We use the VAR and the two BVAR models estimated above to perform an out-of-sample forecasting experiment for the 2017m1–2017m12 period (12 months), focusing on the output gap. The results suggest a gain from Bayesian methods, using the Independent Normal-Wishart prior having the lowest RMSE (0.19). RMSE: root-mean-square error. Compared to VAR(2), BVAR has a lower RMSE, 0.19, given the setting and , implying a relatively uncertain prior for Lambda1 ( adjusts the prior’s overall tightness. Since the volatility of ESG is uncertain about the prior, we set lambda1 to 0.5.

Figure 1 plots the Bayesian forecasting performance of all variables using stochastic simulation and a static solution. We employ static forecasting, using known values, since the Government is not interested in allowing forecasted errors to increment on themselves. We use stochastic simulation to yield a distribution of possible values. The static solution performs great for all variables, both in terms of fit and standard error bounds.

**Figure 1: Stochastic simulation ‒ static solution forecast of Bayesian Independent normal- Wishart GDP\_GAP**



*Note:* The model for BVAR(2) is estimated for the period January 2006 to December 2016 and is forecast for the period January 2017 to December 2017. This shows the forecasting performance for the BVAR model using the Independent normal-Wishart prior.

* 1. *Sensitivity analysis*

We analyze sensitivity by increasing renewable energy and government effectiveness (scenario 1 and scenario 2) and decreasing energy, agriculture and land, waste, and industrial process emissions of CO2 (scenario 3, scenario 4, scenario 5, and scenario 6), respectively, by ±10%, ±20%, ±30%, ±40%, ±50%, and ±60% during the period from January 2019 to June 2019. The hypothetical direct effect begins in January 2017 and continues until the end of June 2017. The policymakers are interested to see the accumulative effect of all six scenarios and their forecasting performance.

Figure 2 shows scenario 7, the forecasting performance accumulatively. If we combine simultaneously the six scenarios, we notice that the output gap increases to 266% in just the first six months. Renewable energy, credits, and government effectiveness increased from 43.9 to 69.1, 14.7 to 26.9, and 0.18 to 0.398, respectively, in the period from January 2017 to June 2017.

**Figure 2: Forecasts for scenario 7 (combination of the six scenarios)**







*Note:* This shows the forecasting performance combination of six scenarios for the BVAR(2) model using the Independent normal-Wishart prior. The model for all variables is estimated for the period 2006m1–2016m12 and is forecast for the period 2017m1–2017m12. The figures include real data (blue lines), the baseline (orange lines), and six different scenarios. Simulation scenario (7) shows the combined effects of six scenarios. Agriculture and land, energy, industry, and waste decrease the Gg CO2 emissions CO2 from 664-187 (-71%), 2266-907 (60%), 335-145 (56%), and 265-106 (60%), respectively. The total reduction of CO2 emissions is forecasted to be 2,185 Gg CO2. Apart from climate finance, Montenegro requires a strong focus on promoting and adopting innovative technologies via technology transfer mechanisms. We have reached the crucial implication that the movements of ESG are predictable. This reduces a volatile systematic and systemic risk in the market since we can measure or know the effect of unpredicted ESG shocks.

Montenegro has committed to a 30% reduction in GHG emissions by 2030 (compared to the reference year 1990) as part of its ambitious mitigation target through its NDC, and the above results confirm that the CO2 emission plan (if applied to the six scenarios) would be reduced by 200%, attracting a lot of foreign direct investments (FDI), saving a lot of lives (newborn babies), and accelerating the integration process into the EU.

* 1. *Impulse responses*

The mechanism we use leads us to identify the structural model, which isolates purely exogenous shocks and reveals the responses of the endogenous variables after these shocks hit the economy. We then make predictions about effects such as what will happen to credit or the output gap if macroprudential authorities adopt ESG.

**Figure 3: Impulse response of GDP\_GAP to Energy innovations ±2 S.E.**

**Figure 4: Impulse response of Credit to Renewable energy innovations ±2 S.E.**





Source: authors’ calculations.

*Note:* Figures 3 and 4 show the dynamic impulse responses of GDP\_GAP and credit to exogenous renewable energy economic shocks. The impulse response horizon is 10 months. The impulse response function indicates the change in endogenous variables for each structural shock at t, t+1, and so on. Our goal is to trace out the effects of shocks on the Montenegrin economy. First, we employ Sims’ (1980) orthogonalized impulse response functions.

As the economy is hit by a renewable economy shock, productivity increases for the first 4 months, then flattens for a while until market expectations reach equilibrium and get a positive perspective. Domestic investment increases. How can we interpret the above results? It is to be expected that the news that the country is moving ahead toward integration into the EU, being a member of the North Atlantic Treaty Organization, and seeing everyday reforms in real-market economic activity is perceived positively by a reasonable society. This implies a revision of price expectations in relation to the current price level . There is a clear implication that the market has strong and positive expectations about the introduction of new technology. These results are important since, during crashes, especially Western Balkan markets are highly volatile.[[5]](#footnote-6)

Meanwhile, the risk of high CO2 emissions from energy, waste, industry, and agriculture creates spillover effects in the market, even though the introduction of renewable energy transmits economic growth. This happens because the channel through which they interexchange—CO2 transmitters—enables economic agents to rapidly interconnect due to network effects or platforms. High CO2 transmitters use traditional sectors as a bridge between platforms. This increases the risks related to investor protection and market integrity due to possible corruption, manipulation, or a lack of transparency. This, in turn, increases the risk of broader connectedness volatility.

Internal ESG compliance—ensuring that domestic ESG regulations follow international ones—is another concern for financial integrity. A broader concern related to systemic financial risk is the potential inability of investors to redeem their investments. Another risk is the political scenarios currently developing in the Western Balkans (WB). Close collaboration between financial regulatory agencies within and between WB countries is needed to implement effective financial innovation, encourage consistent regulatory procedures, and identify and address possible risks associated with such ESG innovation. Our results coincide with Aristovnik et al., (2022) who reveal that Good Governance should incorporate a Neo-Weberian approach and New Public Management.

* 1. *Network visualization*

Figure 5 shows the spillover connectedness of the variables.[[6]](#footnote-7) The pairwise connectivity between energy and industrial processes is the strongest (). This is depicted by the largest and darkest gradient green circle and the thickness of the arrow. The second highest pairwise connectivity is from Energy to GDP (). Next, pairwise connectivity is from industry to government effectiveness and credit () and (), respectively, as indicated by the green circle and the thickness of the arrow to the Government effectiveness and credit circles. This is an important fact that is consistent with our results from sensitivity analysis and impulse response.

**Figure 5: ESG macroeconomic spillover connectedness**



*Note:* Figure 5 shows the spillover (connectedness) network. The size of the nodes and the color gradient correspond to the degree. A node with a higher degree is depicted as a larger circle and darker gradient. The thickness of the arrows connecting variables indicates the strength of transmission among variables. The thicker the arrow, the higher the connectedness/spillover. The darkness of the color, circle size, link arrow size, and thickness indicate the strength of pairwise directional connectedness. Since the energy sector is the engine that moves the economy forward, and because a large percentage of energy is imported (importing shocks as well), energy is central to the systematic and systemic spillover connectedness of macroeconomic risk. Even though some other variables are not directly linked with energy, it is an influential platform that directly affects the most important factors of financial stability: inflation and growth. Especially in tranquil times, energy has a higher degree of connectedness with the financial and banking sector, resulting in higher interconnectedness. The net total connectedness spillover of energy is the highest, at 193.60% (). Traditional energy consumption spreads its troubles to other factors the most. Energy, as an imported product, through industry-agriculture-waste has the highest spillover connectedness risk.

In other words, the spillover connectedness from industry to government effectiveness and credit is high. Energy, agriculture, waste, and industry have the potential to destabilize the financial system. Another noticeable feature is that total spillover connectedness from others to industry, GDP, and renewable energy is high, (),(),(). Renewable energy receives contagion spillover effects mostly from energy, agriculture and land, and waste. We have reached a crucial implication: the renewable energy sector is very important and its potential can be reached if appropriate policies are designed to “convert” the deadly CO2 emissions to clear oxygen, increasing the expectations of FDIs and consequently achieving sustainable economic growth.[[7]](#footnote-8),[[8]](#footnote-9)

Since connectedness is of central importance for business, science, academia, and institutional decision-makers under uncertainty, we propose taking a step beyond ESG in future work: specifically, a concept represented by vectors—multidimensional feature space—a quanta concept. This could provide new answers by constructing dynamic, probabilistic systems.

# **Conclusion**

We present a novel macroeconomic model that includes ESG factors. Our main findings, which were obtained via estimating our model using Bayesian connectedness, support the inclusion of ESG in macroeconomic connectedness prediction models. Notably, the chance of mislabeling a clear net distributor of contagion spillover risks as healthy is significantly decreased by the introduction of ESG factors.

Our novel findings indicate that the EU has to immediately assist Montenegro in stabilizing the ESG imbalance since the dangerous and growing ESG imbalance is a historically violent shock for the Western Balkans and the EU. The ESG balance is a major contagion transmitter poised to wreak havoc on the WB and the EMU. Specifically, our novel model indicates that sustainable growth should not be based only on a traditional energy assumption, and reveals the mechanism of key gaps by a prudential authority.

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1. These socioeconomic illnesses continue to defy expectations despite attempts to establish biomarkers utilizing econometric approaches and structural studies (Citterio and King, 2023). Diagnostic standards used in previous literature are based on socioeconomic characteristics that are statistically prevalent but may not always reflect the underlying causes of ESG problems. Outward signs of ESG disparities are complex and widespread, making problem-based policy decisions unreliable, especially since these reactions are often compatible with multiple conclusions. In addition, decisions cannot be made until ESG symptoms develop, which may already be too late for optimal intervention. Despite advancements in mathematics and statistics, the field has so far been unable to define clear mechanisms for classifying and characterizing disorders associated with socioeconomic imbalance. Even modern socioeconomic techniques might only address the effects of ESG imbalance rather than its root causes. Therefore, a dynamic volatility spillover and network connectedness assessment system would be extremely desirable, encouraging policy choices based on clear theoretical and quantitative mechanisms, rather than on their outward manifestations. [↑](#footnote-ref-2)
2. These investigations have yielded a diverse range of results. According to Renneboog et al., (2008) and Derwall and Koedijk (2009), the performance of socially responsible investment (SRI) bond funds is identical to that of their conventional counterparts. Abadie and Imbens (2006), Bollen (2007), and Gi-Bazo et al., (2010), on the other hand, show that during the period 1997–2005, United States SRI funds outperformed conventional funds in terms of both gross and net returns. [↑](#footnote-ref-3)
3. Brzeszczyński et al., (2021) reveal that SRI companies in the Central and Eastern European markets exhibit superior risk-adjusted-performance. Biasin et al., (2022), Consolandi et al., (2009), and Oikonomou et al. (2018) highlight the importance of SRI in asset allocation: an SRI portfolio outperforms an unrestricted portfolio of investments in terms of risk-return trade-offs. Shanaev and Ghimire (2022) show that ESG upgrades boost returns substantially after the start of the COVID-19 pandemic. Halbritter and Dorfleitner (2015) and Auer and Schuhmacher (2016) show that investing in a different portfolio of high and low-rated companies will not generate returns. [↑](#footnote-ref-4)
4. This becomes clear when the standard VAR is iterated backward. For a simple VAR(1), after successive iterations, we get: $Z\_{t}=G\_{0}+ G\_{1}(G\_{0}+G\_{1}(G\_{0}+G\_{1}Z\_{t-3}+ e\_{t-2})+ e\_{t-1})+e\_{t}$,; $Z\_{t}=(I+G\_{1}+G\_{1}^{2}+...+G\_{1}^{\infty })G\_{0}+e\_{t}+\sum\_{i=1}^{\infty }G\_{1}^{i}e\_{t-i}+G\_{1}^{i}X\_{t-n-i}$. $i\rightarrow \infty $ Z reduces to a sum of errors or into a sum of shocks, which is called the Wold representation of Z: $Z\_{t}=μ+\sum\_{i=1}^{+\infty }G\_{1}^{i}e\_{t-i}+e\_{t}$, where $G\_{1}^{i}$ denotes the matrix of coefficients. Assume $ψ\_{i}=G\_{1}^{i}$; then $Z\_{t}=μ+\sum\_{i=1}^{+\infty }ψ\_{i}e\_{t-i}+e\_{t}$. If Z has a Wold representation, then Z is stable. Since VAR is stationary, the estimated reduced-form VAR has a moving average: $X\_{t}=μ+\sum\_{i=1}^{\infty }ψ\_{i}e\_{t-i}$. [↑](#footnote-ref-5)
5. The impulse responses in Figures 3 and 4 reveal significant results. The labor market, society, and workers expect that the economy will grow faster. The wage-setting relation will shift up by more than the price-setting relation, increasing the rate of unemployment. The unadjusted gap remains higher for 6 months until productivity expectations adjust to the new reality. Workers ask for higher wages, but firms cannot afford it, leading to increased unemployment. After some time, workers and society realize that firms have not increased their productivity, thus lowering their expectations, which causes them to accept lower wages, thereby increasing employment. In other words: the dynamics of expectations are *forward-looking*, revealing a fundamental result so far for the market of Montenegro. The market adapts fast to new technologies. This suggests that policymakers need to have an in-depth understanding of the adjustment mechanism of expectations. This implies that the government needs to observe how foreign investors create and change their expectations. Output growth prospers when government authorities adequately anchor expectations. The mechanism of new technology alone is not strong enough to upgrade the economy. Citizens need to have a strong belief in macroprudential policymakers. In other words, anchoring expectations with new ESG platforms brings prosperity. An adjustment process will occur until equilibrium is reached in the free market—that is, until workers’ and firms’ expectations adjust to the new reality. [↑](#footnote-ref-6)
6. There are several distinguishing characteristics in the figure. Some arrows have strong reciprocal directional connectivity, especially for energy, agriculture, and waste. The “received–from” arrows show the share of volatility *obtained* from other variables in the total variance. Similarly, the “transmitted–to” arrows show the share of volatility *distributed* to other variables in the total variance of the forecast error. As Figure 5 shows, the variables are highly differentiated in terms of *receiving* shocks from others and *transmitting* shocks to others. [↑](#footnote-ref-7)
7. The message of Figure 5 is clear: environmental factors are substantial intercountry and intracountry net transmitters of potential instability risk (“to others”–“from others”). Energy has noticeably large total directional connectedness (*to* and *from*), and it remains a clear net *distributor* of spillover risks. One implication of Figure 5 is that *persistent* swings in energy potentially lead to extreme financial instability. In other words, energy’s *persistence* and its varying degrees of effect over time means it is potentially poised to wreak havoc on the system. Contrary to customary assumptions, government effectiveness does not remain immune to the contagion spillover effects. Thus, government effectiveness can be viewed as a bridge of spillover effects. Unexpectedly, we notice that government effectiveness is correlated and connected with agriculture and land, industrial processes, and waste. These sectors do not show effective management and highlight the need for immediate intervention by macroprudential policymakers, especially in the case of speculative or corrupt transactions. This lowers the trust of FDIs, especially in the ESG pathway, but shows great potential for investment. [↑](#footnote-ref-8)
8. Future research could include factors such as anti-bribery and corruption practices, compliance with relevant laws and regulations, structural changes in demand and supply for products, services and commodities, compliance with tax law, international gaps in prudential authority risks, interoperability risks, threats of money laundering and terrorist financing, cryptocurrency platforms, regulatory noncompliance by ESG platforms, information asymmetry, governance of market abuse, scalability, protocol vulnerabilities, operational risks, and risks associated with non-standardized processes. [↑](#footnote-ref-9)