

MONETARY POLICY AND ENERGY MARKET DYNAMICS: EXPLORING THE INTERDEPENDENCE OF CLEAN AND FOSSIL ENERGY SECTORS

[Selvamalai Thiraviyam, School of Economics, University of East Anglia, UK, 07897530985,
s.thiraviyam@uea.ac.uk]

Overview

Global clean energy investment surged from US\$0.565 trillion in 2019 to US\$1.77 trillion in 2023. The growing emphasis on clean energy transition has triggered the focus on dynamics between Environmental, Social, and Governance (ESG) assets and macroeconomic variables. In recent decades, researchers have increasingly concentrated on developing theoretical frameworks to distinguish ESG assets from non-ESG assets. Pedersen et al. (2021) and L'uboš Pástor et al. (2021) developed a ESG-adjusted capital asset pricing models, demonstrating that green investors earn less than their expected returns, while brown (dirty) investors earn more than their expected returns. Further, Feldhütter et al. (2024) empirically found that investors are willing to accept 1–2 basis points lower yield for ESG-labeled bonds to account for environmental externalities.

Many empirical studies have shown that monetary policy significantly affects stock prices (Beckers and Bernoth (2024)) and returns (Maio (2013) and Bernanke and Kuttner (2005)). Simultaneously, stock prices and returns can also bring significant changes in monetary policy (Rigobon and Sack (2003) and Bjørnland and Leitemo (2009)). Although the interactions between monetary policy and stock markets have been explored in the existing literature, limited attention has been given to the sectoral compositions of financial assets based on ESG principles. The objective of this study is to investigate the interaction between monetary policy and clean and dirty energy stock markets. We address the following questions: How do clean and dirty energy stock markets (prices and returns) respond to changes in monetary policy, and vice versa? Do the impulse responses of clean energy market differ from those of the dirty energy markets?

This study makes a notable contribution to the existing literature. To the best of my knowledge, no prior studies have examined the dynamics between stock markets and monetary policy with perspective of ESG principles (ESG and non-ESG assets). This study provide a contrasting empirical evidence on the dynamics between the stock market and monetary policy. Moreover, our findings contribute to the growing literature on ESG assets pricing principles by providing insights into interdependence between monetary policy and ESG asset principles.

The findings of this study offer several key implications for policymakers and investors. Our contrasting evidence on stock market responses to an impulse in FFR encourages policymakers (especially monetary authorities), to adopt a broader perspective beyond traditional view on the financial market outcomes of monetary policy actions. This can assist policymakers to navigate clean energy transitions in mitigating global warming and , implementing effective policies to reduce greenhouse gas emissions through the integration of ESG principles into financial market strategies. The surprising findings of this study makes a platform for the future researchers to explore further theoretically and empirically on the dynamics between stock markets and monetary policy.

Methods and Data

Building on prior research, including Bernanke and Kuttner (2005), Rigobon and Sack (2003), Bjørnland and Leitemo (2009) and Maio (2013), we employed an event study approach and a Structural VAR (SVAR) model to investigate the interdependence of clean and dirty energy markets with monetary policy. Cholesky factorization and the heteroskedasticity method proposed by Rigobon (2003) were utilized to extract the structural shocks from the reduced form VAR residuals. Consistent with studies of Thorbecke (1997), Bernanke and Kuttner (2005) and Bjørnland and Leitemo (2009), we selected five key variables for analysis: the annual change in the logarithm of consumer prices, the annual change in the logarithm of commodity prices, the logarithm of industrial production, the federal funds rate (FFR) as a proxy for monetary policy, and a stock market indicator that includes clean energy, dirty energy, and the S&P 500 deflated by consumer prices. For the stock indicator, both the level and the first difference of the logarithms of real stock prices were considered. The data for this study consist of monthly time series for the U.S. economy, sourced from Refinitiv Eikon, spanning from December 2007 to October 2024.

Results, Discussion and Conclusion

The analysis of this study begins with an event study approach, following Thorbecke (1997), Bernanke and Kuttner (2005) and Maio (2013). Surprisingly, we fund a positive and statistically significant responses of clean and dirty energy stock market returns to changes in the FFR. The positive response was more pronounced for clean energy returns (11.7%) compared to dirty energy returns (9.92%).

In the next step, we employed the SVAR model to analyze the dynamic relationship between the stock markets and the FFR. Previous studies, such as Patelis (1997), Bernanke and Kuttner (2005) and Thorbecke (1997), as-

sumed that the stock market responds contemporaneously to monetary policy shocks but not vice versa. They utilized Cholesky factorization to identify the structural shocks. In contrast, Rigobon and Sack (2003), Bjørnland and Leitemo (2009), Arias et al. (2019), Galí and Gambetti (2015), Aastveit et al. (2023) proposed simultaneous interactions between monetary policy and stock markets and used alternative approaches to identify the structural shocks. Therefore, this study first applies Cholesky factorization, assuming no contemporaneous response of the FFR. We then utilize the heteroskedasticity-based approach to account for the instantaneous simultaneous interactions.

Surprisingly, this study found a positive and statistically significant contemporaneous response of both clean and dirty energy stock markets (prices and returns) to an impulse in FFR in the both approaches. Further, the structural impulse response function analyses show that the prices and returns for clean and dirty energy markets responded positively to a one time positive shock in the FFR over the period. These findings are beyond the expectations of theoretical and previous empirical studies on a response of stock market to monetary policy. A possible reason for this could be related to our recent study period (December 2007 to October 2024), which differs significantly from periods considered in the previous studies. Several major events impacted the US economy during our study period, such as the financial crisis (2007-2008), the oil price crash (2014), the 2016 US presidential election (Wagner et al. (2018)) and 2017 tax cut, the COVID pandemic, and the Russia-Ukraine war (2022).

Further, we found that increases in clean energy prices and returns tends to lower the FFR, while increase in dirty energy prices and returns lead to rise the FFR over the time. Interestingly, this study found that the shape of the response function of the FFR to impulses in clean energy markets (price and return) is the inverse of the response function of the FFR to impulses in dirty energy prices and returns. The positive response of FFR to dirty energy markets is in line with previous studies (Rigobon and Sack (2003), Bjørnland and Leitemo (2009), Arias et al. (2019), Galí and Gambetti (2015), Aastveit et al. (2023)). Although the negative response of the FFR to clean energy market shocks is inconsistent with those pervious studies, the finding aligns expectations of ESG principles and ESG-adjusted asset pricing models (Pedersen et al. (2021), L'uboš Pástor et al. (2021) and Feldhütter et al. (2024)).

References

- Aastveit, K.A., Furlanetto, F., Loria, F., 2023. Has the Fed Responded to House and Stock Prices? A Time-Varying Analysis. *The Review of Economics and Statistics* 105, 1314–1324. URL: https://doi.org/10.1162/rest_a_01120, doi:10.1162/rest_a_01120, arXiv:https://direct.mit.edu/rest/article-pdf/105/5/1314/2158489/rest_a_01120.pdf.
- Arias, J.E., Caldara, D., Rubio-Ramírez, J.F., 2019. The systematic component of monetary policy in svars: An agnostic identification procedure. *Journal of Monetary Economics* 101, 1–13. URL: <https://www.sciencedirect.com/science/article/pii/S0304393218303908>, doi:<https://doi.org/10.1016/j.jmoneco.2018.07.011>.
- Beckers, B., Bernoth, K., 2024. Monetary policy and mispricing in stock markets. *Journal of Money, Credit and Banking* 56, 1887–1904. doi:<https://doi.org/10.1111/jmcb.13090>.
- Bernanke, B.S., Kuttner, K.N., 2005. What explains the stock market's reaction to federal reserve policy? *The Journal of Finance* 60, 1221–1257. doi:<https://doi.org/10.1111/j.1540-6261.2005.00760.x>.
- Bjørnland, H.C., Leitemo, K., 2009. Identifying the interdependence between us monetary policy and the stock market. *Journal of Monetary Economics* 56, 275–282. URL: <https://www.sciencedirect.com/science/article/pii/S0304393208001748>, doi:<https://doi.org/10.1016/j.jmoneco.2008.12.001>.
- Feldhütter, P., Halskov, K., Krebbers, A., 2024. Pricing of sustainability-linked bonds. *Journal of Financial Economics* 162, 103944. doi:<https://doi.org/10.1016/j.jfineco.2024.103944>.
- Galí, J., Gambetti, L., 2015. The effects of monetary policy on stock market bubbles: Some evidence. *American Economic Journal: Macroeconomics* 7, 233–57. doi:10.1257/mac.20140003.
- Maio, P., 2013. Another Look at the Stock Return Response to Monetary Policy Actions*. *Review of Finance* 18, 321–371. doi:10.1093/rof/rfs050.
- Patelis, A.D., 1997. Stock return predictability and the role of monetary policy. *The Journal of Finance* 52, 1951–1972.
- Pedersen, L.H., Fitzgibbons, S., Pomorski, L., 2021. Responsible investing: The esg-efficient frontier. *Journal of Financial Economics* 142, 572–597. doi:<https://doi.org/10.1016/j.jfineco.2020.11.001>.
- L'uboš Pástor, Stambaugh, R.F., Taylor, L.A., 2021. Sustainable investing in equilibrium. *Journal of Financial Economics* 142, 550–571. doi:<https://doi.org/10.1016/j.jfineco.2020.12.011>.
- Rigobon, R., 2003. Identification Through Heteroskedasticity. *The Review of Economics and Statistics* 85, 777–792. doi:10.1162/003465303772815727.
- Rigobon, R., Sack, B., 2003. Measuring The Reaction of Monetary Policy to the Stock Market*. *The Quarterly Journal of Economics* 118, 639–669. doi:10.1162/003355303321675473.
- Thorbecke, W., 1997. On stock market returns and monetary policy. *The Journal of Finance* 52, 635–654.
- Wagner, A.F., Zeckhauser, R.J., Ziegler, A., 2018. Company stock price reactions to the 2016 election shock: Trump, taxes, and trade. *Journal of Financial Economics* 130, 428–451. URL: <https://www.sciencedirect.com/science/article/pii/S0304405X18301739>, doi:<https://doi.org/10.1016/j.jfineco.2018.06.013>.