

The Time-Varying Optimal Portfolio Design with Minimum Risk: New Evidence from a Time-Varying Parameter Vector Autoregression Model

*Saeed Farahanifard**

*Sanaz Rahimi***

*Soheil Roudari****

Doi: <https://doi.org/10.22096/esp.2025.2044734.1793>

Received Date: 02/11/2025 - Accepted Date: 12/02/2026

Abstract

This study aims to design an optimal investment portfolio to minimize risk and enhance returns. Using daily data from 10 active companies listed on the Tehran Stock Exchange from October 30, 2016, to April 29, 2023, we employ the Time-Varying Parameter Vector Autoregression (TVP-VAR) model. Portfolio optimization is conducted using the Minimum Variance Portfolio (MVP), Minimum Correlation Portfolio (MCP), and Minimum Connectivity Portfolio (MCoP) approaches. The results show that the MVP strategy yields the highest cumulative portfolio returns. Under normal market conditions, the largest optimal weights are allocated to Damavand (19%), Tapico (18%), and Seshahd (15%), whereas asset compositions shift significantly during bullish and bearish markets. Dynamic weight analysis indicates that certain companies, such as Shetran and Tapico, play a crucial role in risk hedging during specific periods. This study demonstrates that using dynamic, time-varying models improves analytical accuracy and aligns more closely with market realities. It also emphasizes the importance of educating investors on dynamic portfolio management and advanced tools for adjusting investment portfolios. The findings offer valuable insights for policymakers and market participants, highlighting the need for flexible investment strategies that can adapt to evolving market conditions.

Keywords: Investment Portfolio; Dynamic Optimization; Volatility Spillover; TVP-VAR Model.

JEL Classification: G11, C32, C58, G15.

* Professor, Faculty of Economic and Administrative Sciences, University of Qom, Qom, Iran.
(Corresponding author)

Email: s.farahanifard@qom.ac.ir

** PhD student in Economic Sciences, Faculty of Economic and Administrative Sciences,
University of Qom, Qom, Iran.

Email: s.rahimi@stu.qom.ac.ir

*** PhD in Economic Sciences, Faculty of Administrative and Economic Sciences, Ferdowsi
University, Mashhad, Iran.

Email: soheil.roudari@gmail.com



Bibliography

- Abdullah, Mohammad, Mohammad Ashraful Ferdous Chowdhury, and Zunaidah Sulong. "Asymmetric efficiency and connectedness among green stocks, halal tourism stocks, cryptocurrencies, and commodities: Portfolio hedging implications." *Resources Policy* 81 (2023): 103419. <https://doi.org/10.1016/j.resourpol.2023.103419>.
- Abdulnasser, Hatemi-J, Roca Eduardo, and Mustafa Alan. "Portfolio diversification impact of oil and asymmetric interaction between oil, equity and bonds in the global market: fresh evidence from alternative approaches." *Economic Studies* 50, no. 4 (2023): 790-805. <https://doi.org/10.1108/JES-04-2022-0214>.
- Ahmed, Abdullahi D., and Rui Huo. "Volatility transmissions across international oil market, commodity futures and stock markets: Empirical evidence from China." *Energy Economics* 93 (2021): 104741. [10.1016/j.eneco.2020.104741](https://doi.org/10.1016/j.eneco.2020.104741)
- Alshater, Muneer M., Huthaifa Alqaralleh, and Rim El Khoury. "Dynamic asymmetric connectedness in technological sectors." *The Journal of Economic Asymmetries* 27 (2023): e00287. <https://ideas.repec.org/a/eee/joecas/v27y2023ics1703494922000470.html#:~:text=DOI%3A%2010.1016/j.jeca.2022.e00287>.
- Antonakakis, Nikolaos, Ioannis Chatziantoniou, and David Gabauer. "Refined measures of dynamic connectedness based on time-varying parameter vector autoregressions." *Risk and Financial Management* 13, no. 4 (2020): 84. <https://doi.org/10.3390/jrfm13040084>.
- Argha, Leila, Mohammad Molaei, and Mohsen Khezri. "Investigating Impact of the Selected Domestic and Foreign Assets Returns on Stock Price Index Returns in Iran: An Approach from DCC-FIAPARCH Model." *Quarterly Journal of Applied Theories of Economics* 6, no. 4 (2019): 251-274. <https://sid.ir/paper/386093/fa>. [In Persian]
- Armen, Aziz, Ebrahim Anvari, and Samereh Raki Kianpour. "Modeling the Dynamic Index of Financial Conditions and Examining Its Impact on the Predictability of Iran's Stock Returns." *Asset Management and Financing* 1, no. 36 (2022): 47-72. <https://doi.org/10.22108/amf.2022.129138.1672>. [In Persian]
- Arouri, M., J. Jouini, and DK Nguyen. "Volatility spillovers between oil prices and stock sector returns: Implications for portfolio management." *Money and Finance* 7, no. 30 (2011): 1387-1405. <https://doi.org/10.1016/j.jimonfin.2011.07.008>

- Ashna, Maliheh, and Hamid Lale Khezri. "Dynamic Correlation of Exchange Rate, Export and Import Volatility with The Global Economic Policy Uncertainty Index (Application of M-GARCH and DCC Approach)." *Journal of Applied Economics Studies in Iran* 15, no. 2 (2021): 147-172. <https://sid.ir/paper/400803/fa>. [In Persian]
- Bai, Lan, Yu Wei, Jiahao Zhang, Yizhi Wang, and Brian M. Lucey. "Diversification effects of China's carbon neutral bond on renewable energy stock markets: A minimum connectedness portfolio approach." *Energy Economics* 123 (2023): 106727. <https://doi.org/10.1016/j.eneco.2023.106727>
- Broadstock, David C, Chatziantoniou Ioannis, and Gabauer David. "Minimum connectedness portfolios and the market for green bonds: Advocating socially responsible investment (SRI) activity." *SSRN Electronic* (2020). <https://dx.doi.org/10.2139/ssrn.3793771>
- Cao, Guangxi, and Wenhao Xie. "Asymmetric dynamic spillover effect between cryptocurrency and China's financial market: Evidence from TVP-VAR based connectedness approach." *Finance Research Letters* 49 (2022): 103070. <https://doi.org/10.1016/j.frl.2022.103070>
- Chatziantoniou, Ioannis, David Gabauer, and Rangan Gupta. "Integration and risk transmission in the market for crude oil: New evidence from a time-varying parameter frequency connectedness approach." *Resources Policy* 84 (2023): 103729. <https://doi.org/10.1016/j.resourpol.2023.103729>
- Christoffersen, Peter, Errunza Vihang, Jacobs Kris, and Jin Xisong. "Correlation dynamics and international diversification benefits." *Forecasting*, no. 30 (2014): 807-824. <https://doi.org/10.1016/j.ijforecast.2014.01.001>.
- Dadmehr, Mehrdad, Fereydoun Rahnamaye Roodposhti, Hashem Nikoumaram, and Mir Feyzollah Falah Shams. "Investigating the Effects of Contagion Between Monetary and Financial Markets of Iran." *Journal of Economics and Modelling* 12, no. 2 (2021): 123-166. <https://doi.org/10.29252/jem.2021.224004.1665>. [In Persian]
- Diebold, Francis X, and Kamil Yilmaz. "Better to give than to receive: Predictive directional measurement of volatility spillovers." *Forecasting* 28, no. 1 (2012): 57-66. <https://doi.org/10.1016/j.ijforecast.2011.02.006>.
- Diebold, Francis X, and Kamil Yilmaz. "On the network topology of variance decompositions: Measuring the connectedness of financial firms." *Econometrics* 182, no. 1 (2014): 119-134. <https://doi.org/10.1016/j.jeconom.2014.04.012>.

- Ederington, Louis H. "The hedging performance of the new futures markets." *Finance* 34, no. 1 (1979): 157-170. <https://doi.org/10.2307/2327150>
- Gkillas, Konstantinos, Dimitrios I. Vortelinos, and Tahir Suleman. "Asymmetries in the African financial markets." *Multinational Financial Management*, no. 45 (2018): 72-87. <https://doi.org/10.1016/j.mulfin.2018.04.004>.
- Gupta, Abhinav, Sucheta Nadkarni, and Misha Mariam. "Dispositional sources of managerial discretion: CEO ideology, CEO personality, and firm strategies." *Administrative Science Quarterly* 64, no. 4 (2019): 855-893. <http://dx.doi.org/10.1177/0001839218793128>
- Hashemi, Amir Mahdi, Mohammad Khodai Valdzagard, Abbas Memarnejad, and Asghar Abolhasani Hasti. "The Relationship of Return on Investment Markets with the Debold and Yelmaz Approach." *Financial Engineering and Securities Management* 11, no. 44 (2020): 446-478. <https://sid.ir/paper/397495/fa>. [In Persian]
- Hosseini Ebrahimabad, Ali, Khalil Jahangiri, Hassan Heydari, and Mehdi Ghaemi Asl. "Study of Shock and Volatility Spillovers among Selected Indices of the Tehran Stock Exchange Using Asymmetric BEKK-GARCH Model." *Journal of Applied Economics Studies in Iran* 8, no. 29 (2019): 123-155. <https://doi.org/10.22084/aes.2018.15376.2578>. [In Persian]
- Karami, Sepideh, and Mohammad Ali Rastgar. "Estimating the Spillover Effects of Returns and Volatility among Various Industries in the Tehran Stock Market." *Financial Engineering and Securities Management* 9, no. 35 (2018): 323-342. <https://sid.ir/paper/197714/fa>. [In Persian]
- Karolyi, G. Andrew. "A multivariate GARCH model of international transmissions of stock returns and volatility: The case of the United States and Canada." *Business & Economic Statistics*, no. 13 (1995): 11-25. <https://econpapers.repec.org/RePEc:bes:jnlbes:v:13:y:1995:i:1:p:11-25>
- Koop, Gary, M. Hashem Pesaran, and Simon M. Potter. "Impulse response analysis in nonlinear multivariate models." *Econometrics* 74, no. 1 (1996): 119-147. [https://doi.org/10.1016/0304-4076\(95\)01753-4](https://doi.org/10.1016/0304-4076(95)01753-4)
- Liow, Kim Hiang, Jeongseop Song, and Xiaoxia Zhou. "Volatility connectedness and market dependence across major financial markets in China economy." *Quantitative Finance and Economics* 5, no. 3 (2021): 397-420. <https://doi.org/10.3934/QFE.2021018>
- Markowitz, Harry M. *Portfolio Selection: Efficient Diversification of Investments*. New York: John Wiley & Sons, 1959.
- Mohajeri, Parisa, and Reza Taleblou. "Investigating the Dynamics of Volatility

- Spillovers across Sectors' Returns Utilizing a Time-Varying Parameter Vector Autoregressive Connectedness Approach; Evidence from Iranian Stock Market." *Journal of Economic Research (Tahghighat- E- Eghtesadi)* 57, no. 2 (2023): 321-356. <https://doi.org/10.22059/jte.2023.349895.1008727>. [In Persian]
- Mohseni, Hossein, and Mohammad Hashem Batcheskan. "Investigating Conditional correlation among Industries in the Capital Market." *Budget and Finance Strategic Research* 1, no. 1 (2020): 75-91. <https://dorl.net/dor/20.1001.1.27171809.1399.1.1.3.2>. [In Persian]
- Pesaran, H. Hashem, and Yongcheol Shin. "Generalized impulse response analysis in linear multivariate models." *Economics letters* 58, no. 1 (1998): 17-29. [https://doi.org/10.1016/S0165-1765\(97\)00214-0](https://doi.org/10.1016/S0165-1765(97)00214-0).
- Pourahmadi, Zahra, and Amir Abbas Najafi. "Dynamic Portfolio Optimization with Transaction Cost." *Financial Engineering and Securities Management* 6, no. 24 (2015): 153-172. <https://sid.ir/paper/396919/fa>. [In Persian]
- Rehman, Mobeen Ur, Xuan Vinh Vo, Hee-Un Ko, Nasir Ahmad, and Sang Hoon Kang. "Quantile connectedness between Chinese stock and commodity futures markets." *Research in International Business and Finance* 64 (2023): 101810. [10.1016/j.ribaf.2022.101810](https://doi.org/10.1016/j.ribaf.2022.101810).
- Roudari, Soheil, Saeed Farahani Fard, Abolfazl Shahabadi, and Omid Ali Adeli. "Investigating the Time-Frequency Volatility Spillover among Exchange Rate, Inflation, Stocks and Housing Prices in Iran." *Journal of Economics and Modelling* 13, no. 2 (2022): 65-93. <https://doi.org/10.29252/jem.2022.228781.1783>. [In Persian]
- Taleblou, Reza, and Parisa Mohajeri. "Modeling the Transmission of Volatility in the Iranian Stock Market Space-State Nonlinear Approach." *Journal of Economic Research (Tahghighat- E- Eghtesadi)* 55, no. 4 (2021): 963-990. <https://doi.org/10.22059/jte.2021.322088.1008455>. [In Persian]
- Taleblou, Reza, Parisa Mohajeri, Abbas Shakeri, Taymour Mohammadi, and Zahra Zabihi. "Estimating the Systemic Risk and Volatility Spillovers among Industries Listed Stock Market and Its Application in Optimal Portfolio; TVP-VAR Approach." *Iranian Journal of Economic Research* (2024). <https://doi.org/10.22054/ijer.2024.77367.1250>. [In Persian]
- Tiwari, Aviral Kumar, Emmanuel Joel Aikins Abakah, David Gabauer, and Richard Adjei Dwumfour. "Green bond, renewable energy stocks and carbon price: Dynamic connectedness, hedging and investment strategies

during COVID-19 pandemic.” *Hedging and Investment Strategies during COVID-19 pandemic* (August 1, 2021) (2021). <http://dx.doi.org/10.2139/ssrn.3897284>.

Wei, Yu, Yizhi Wang, Samuel A. Vigne, and Zhenyu Ma. “Alarming contagion effects: the dangerous ripple effect of extreme price spillovers across crude oil, carbon emission allowance, and agriculture futures markets.” *Journal of International Financial Markets, Institutions and Money* 88 (2023): 101821. <https://doi.org/10.1016/j.intfin.2023.101821>.

Yunus, Nafeesa. “Time-varying linkages among gold, stocks, bonds and real estate.” *The Quarterly Review of Economics and Finance* 77 (2020): 165-185. [10.1016/j.qref.2020.01.015](https://doi.org/10.1016/j.qref.2020.01.015).