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RESEARCH & COLLABORATION PROFILE |

KEY WORDS: Dynamic Portfolio Optimization, Stochastic Control, Physics-Informed Neural Networks, Machine Learning for Asset Pricing, Generative Models for Financial Time Series

Research Snapshot. Dr. Jeong develops neural-network methods for dynamic portfolio choice, forecasting, and risk modeling, grounded in stochastic control and asset-pricing theory. His work spans Pontryagin-guided policy optimization, physics-informed policy iteration, and control with state delays; reliability-screened equity-premium forecasting and economic-condition-aware dynamic correlations; financial time-series generation, neural valuation surrogates, and transfer learning for data-scarce assets. Methods are evaluated against analytical benchmarks and, where applicable, out-of-sample market data.

RESEARCH EXPERTISE

- **Neural stochastic control:** Pontryagin-guided direct policy optimization (PG-DPO), simulation-based adjoint policy iteration, infinite-horizon portfolio choice, and control with state delays.
- **Physics-informed methods & verification:** PINN-based HJB policy iteration for control-dependent diffusion; complementary work on constrained portfolios and residual-based welfare certification.
- **Forecasting & risk modeling:** reliability-screened equity-premium prediction, LSTM dynamic-correlation and cross-market volatility forecasting, and ML-based economic scenario generation.
- **Generative & surrogate models:** factor-based MarketGANs; VMD-based dual uncertainty via LSTM with concrete dropout and WGAN-GP; DeepONet pricing surrogates; learned SDE simulation.
- **Empirical validation:** CRSP/WRDS pipelines, Fama-French industry universes, walk-forward out-of-sample backtesting, and reproducible GPU experiment frameworks.

RECENT RESEARCH HIGHLIGHTS

- **Differentiating through delay (working paper):** recovers adjoint and current-state curvature inputs for state-delay control refinement through fixed-control path differentiation, without assembling full history Hessians.
- **Self-consistent adjoint policy iteration (working paper):** re-estimates adjoints under each deployed policy and solves convex-constrained CRRA portfolio updates, with adjoint–HJB consistency analysis and conditional population-level convergence.
- **Neural policy iteration with control-dependent diffusion (working paper):** alternates linear PINN policy evaluation and explicit greedy updates, validated on multi-asset Merton and Kim–Omberg benchmarks.
- **MarketGANs (working paper):** uses a factor-based GAN to generate joint return scenarios, preserving cross-sectional dependence and tail co-movement in data-scarce settings.

POTENTIAL COLLABORATION RESEARCH

Best-fit collaborator areas: stochastic control & applied mathematics | computational finance & asset pricing | machine learning & scientific ML | risk management & scenario modeling

1. **Neural solvers for stochastic control and PDEs:** adapting PG-DPO and PINN policy iteration to constrained control and HJB problems beyond finance; exploring delayed and non-Markovian systems in engineering, epidemiology, and energy.
2. **Machine learning for forecasting and risk modeling:** return, volatility, and dynamic-correlation forecasting under changing economic conditions, with emphasis on out-of-sample validation and economic value.
3. **Generative and surrogate models for scenario generation and pricing:** GAN-based scenario engines, neural pricing surrogates, and accelerated simulation for valuation and stress testing, building on economic-scenario project experience with Korea Asset Pricing.
4. **Portfolio decision-making under regime shifts:** developing and evaluating allocation strategies under changing market conditions and forecast uncertainty.

SELECTED RECENT PUBLICATIONS

- **PLOS ONE 2026, 21(5), e0341578 —** Equity premium forecasting with reliability-screened forward-looking signals.
- **Comput. Econ. 2026, 67(6), 4953–4987 —** Learning distributions for continuous-time financial models.
- **Finance Res. Lett. 2025, 86, 108425 —** LSTM-based dynamic correlation forecasting with economic conditions.
- **J. Ind. Manag. Optim. 2025, 21(9), 5687–5715 —** Pontryagin-guided direct policy optimization for continuous-time portfolio problem.

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https://swon-jeong-finance.github.io

REPRESENTATIVE RESEARCH FIGURES / SCHEMES

Conceptual Markovian PG-DPO workflow

