Green Stocks Analysis

Candidate Number: 34149, 39295, 34677, 45428

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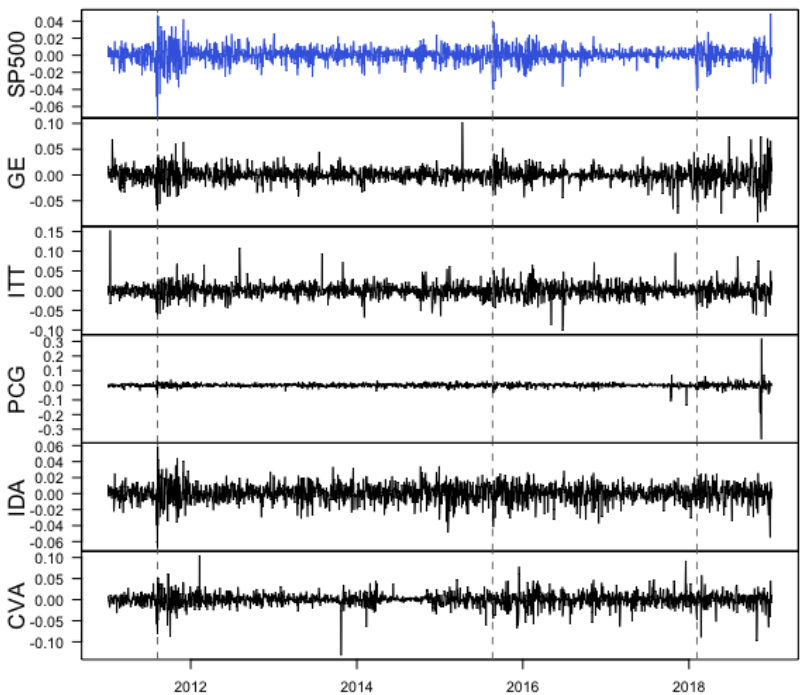
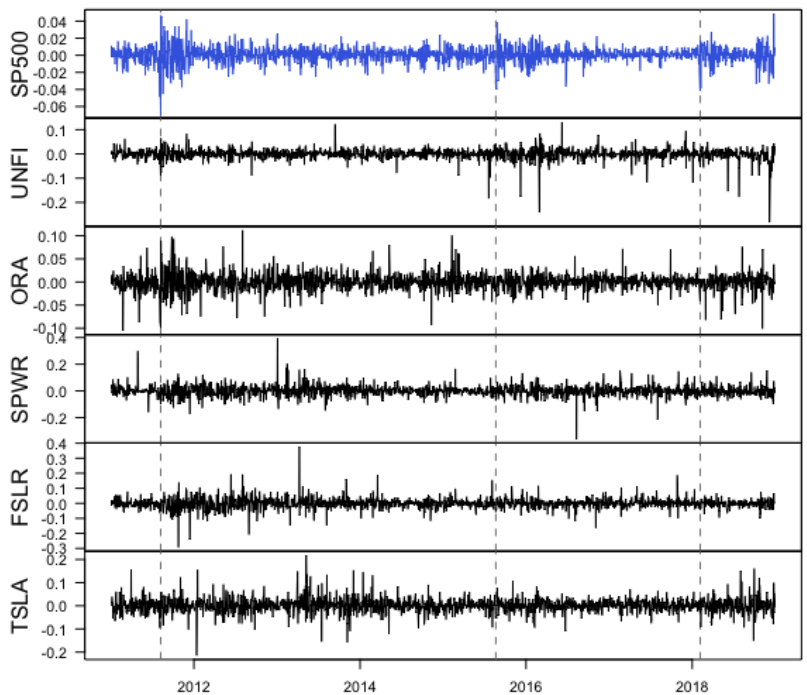
Data and Log Returns

GE(wind power), ITT(water purification), PCG(hydro operation), IDA(hydro operation), CVA(waste reduction), UNFI(organics), ORA(geothermal), SPWR(solar energy), FSLR(solar energy), TSLA(green transportation)

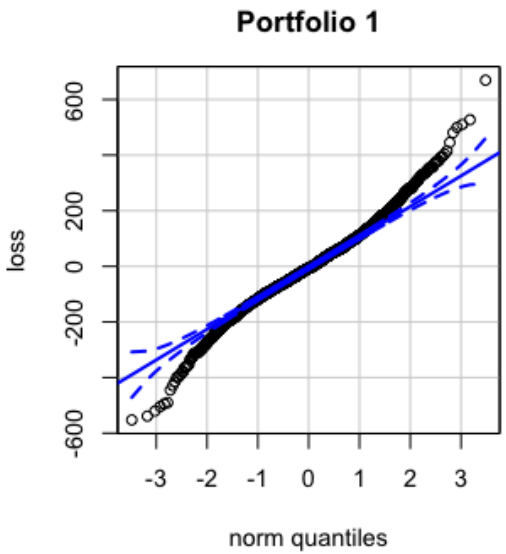
- Volatility clustering
- Contemporaneous dependence due to market factors
- Strong tail dependence in solar energy sector (SPWR, FSLR, TSLA)

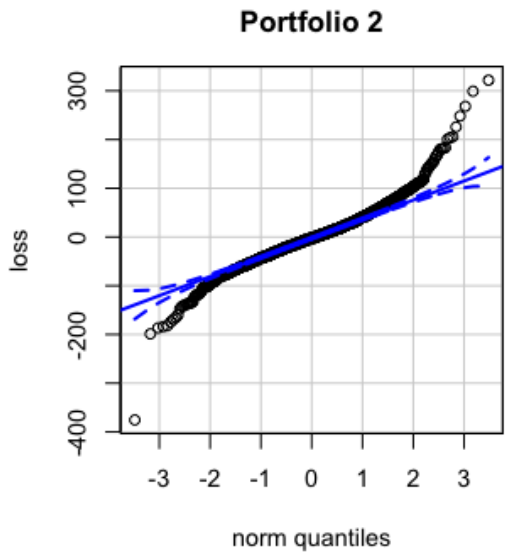


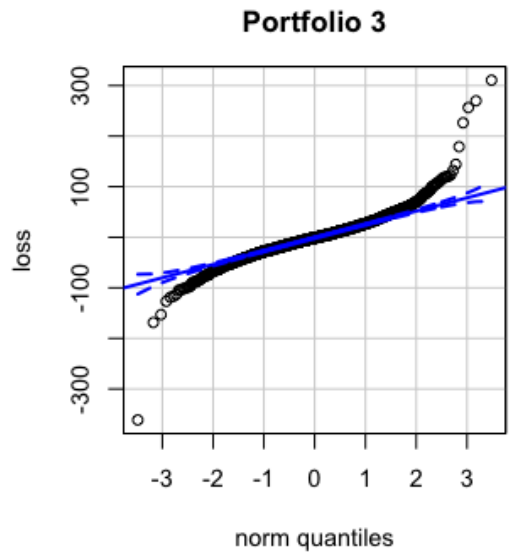


Portfolio Loss and Risk Measures

- Normality of portfolio losses is rejected
- Multivariate normality of log returns is rejected





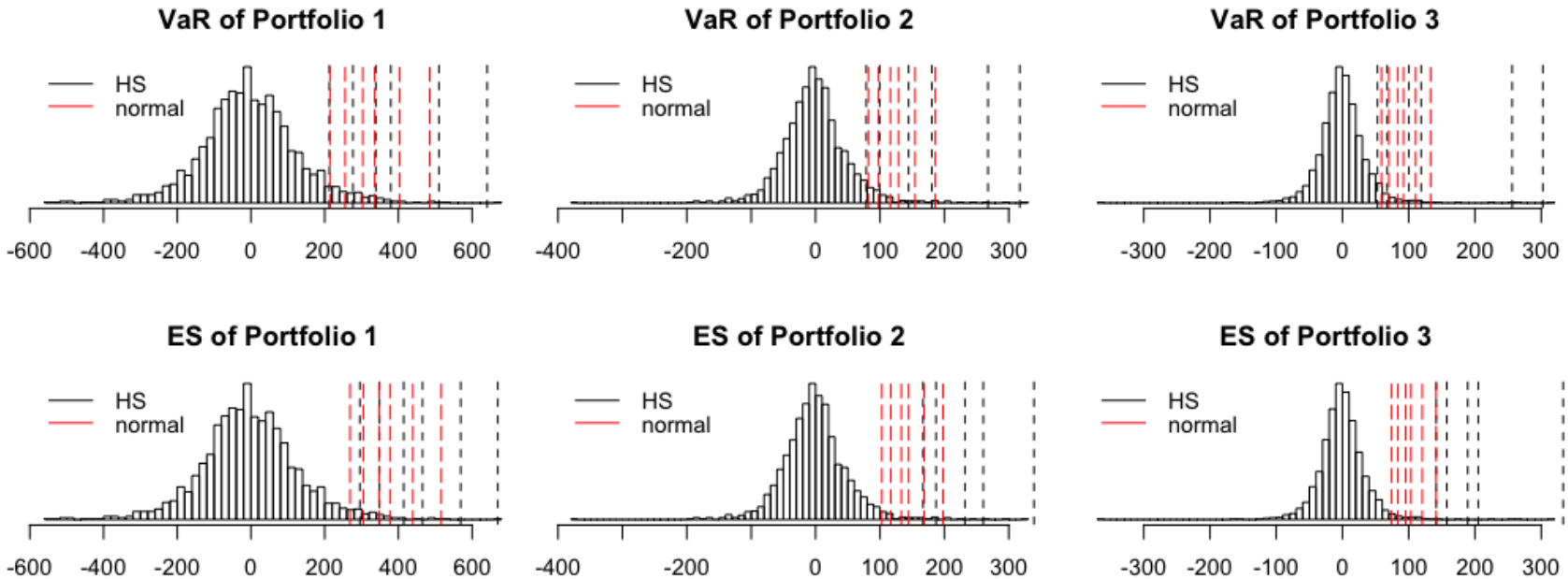


JB test	**pf 1**	**pf 2**	**pf 3**
p-value	0	0	0

Mardia test	**pf 1**	**pf 2**	**pf 3**
p-value(b,k)	(0,0)	(0,0)	(0,0)

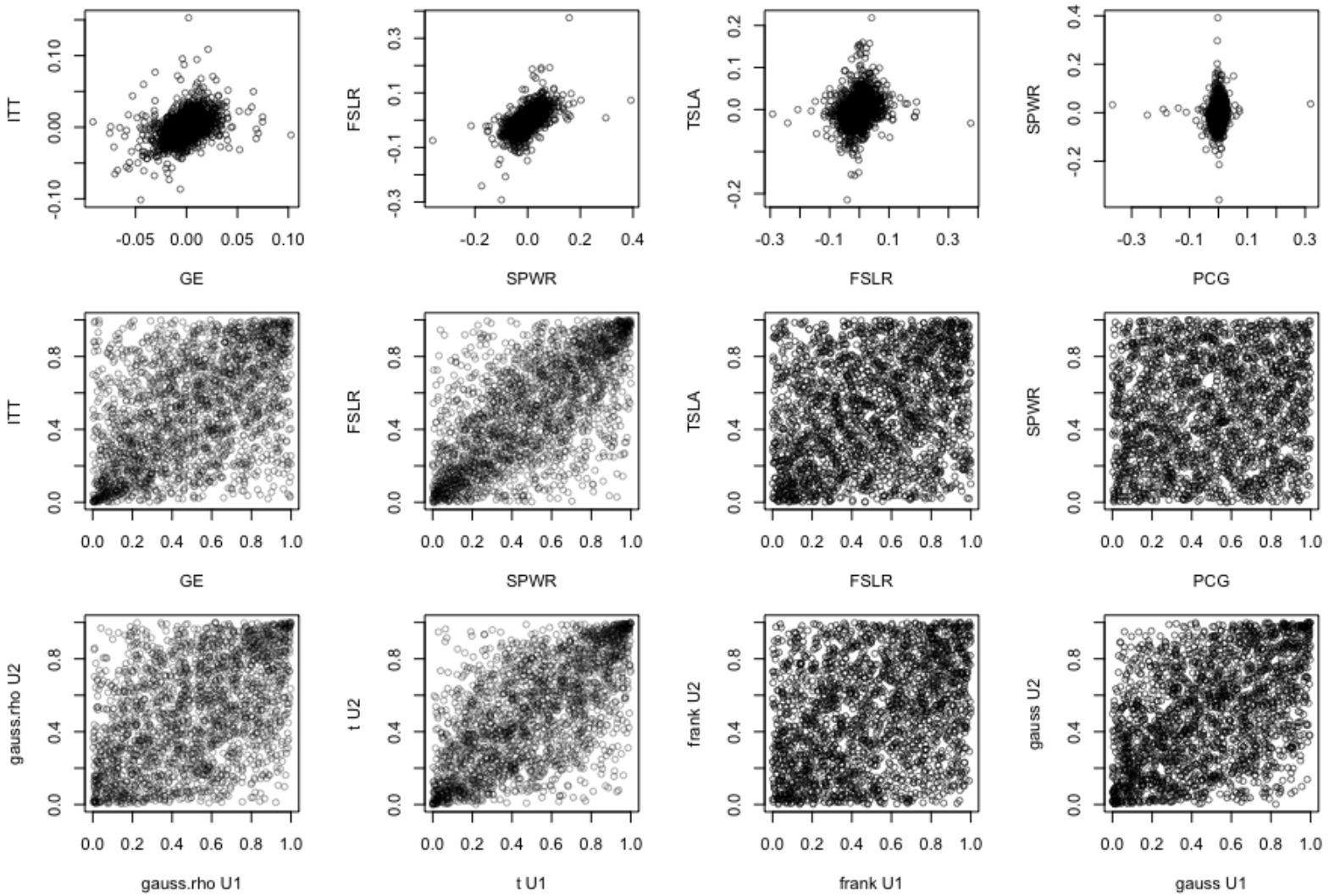
Portfolio Loss and Risk Measures

- Loss distributions are heavy-tailed
- Using normal distribution would underestimate VaR and ES



Copula and Dependence

Figure: Top: log returns, Middle: pseudo observations, Bottom: simulations



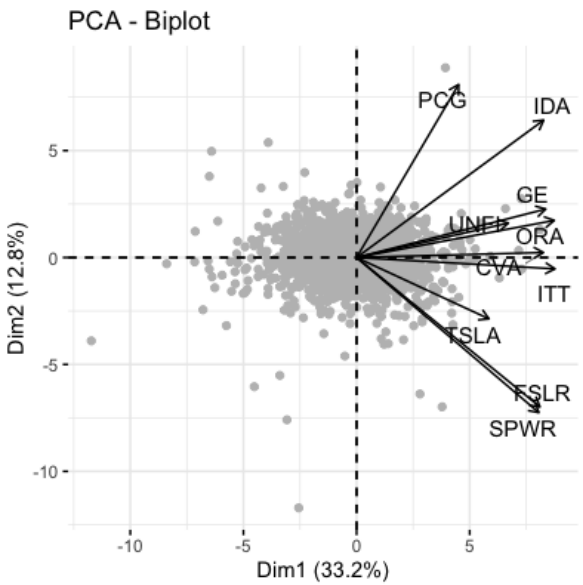
Copula and Dependence

Table: Summary of fits for FSLR-TSLA

FSLR-TSLA	**gof p-value**	**BIC**	**loglik**	ρ_S	τ	λ_L	λ_U
gauss	0.0423	-153	80.3	0.267	0.18	0	0
gauss.rho	0.938	-152	79.8	0.286	0.193	0	0
t	0.112	-152	83.7	0.275	0.185	0.00612	0.00612
t.tau	0.415	-152	83.5	0.289	0.195	0.00739	0.00739
frank	0.0622	-168	87.7	0.293	0.198	0	0
frank.tau	0.296	-168	87.7	0.289	0.195	0	0
gumbel	0.00249	-122	64.8	0.24	0.161	0	0.212
gumbel.tau	0.00249	-116	61.7	0.288	0.195	0	0.253
clayton	NA	NA	NA	NA	NA	NA	NA
clayton.tau	0.00249	-115	61.2	0.288	0.195	0.239	0

PCA

- The first principal component (33.2%): market factor
- The second principal component (12.8%): volatility against market
- $\rho_{Comp.1,SP500} = 0.739$, $\tau_{Comp.1,SP500} = 0.555$
- $\rho_{Comp.2,SP500} = -0.29$, $\tau_{Comp.2,SP500} = -0.197$



Marshall-Olkin Copula

$$C^{MO}_{\alpha,\beta}(u,v) = \min(u^{1-\alpha}v, uv^{1-\beta}) = \begin{cases} u^{1-\alpha}v, & \text{if } u^{\alpha} \geq v^{\beta} \\ uv^{1-\beta}, & \text{if } u^{\alpha} \leq v^{\beta} \end{cases}, \quad 0 \leq \alpha, \beta \leq 1$$

Figure: Scatter plots of simulations

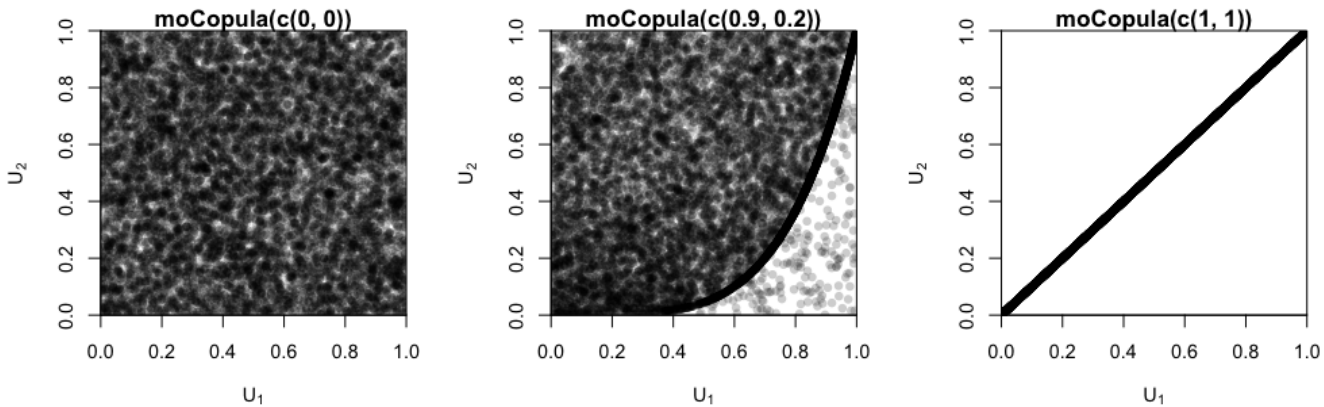


Table: Summary of fits

	GE-ITT	SPWR-FSLR	FSLR-TSLA	PCG-SPWR	Comp.1-SP500	Comp.2-SP500
α	0.02772	0.04704	0.01853	-0.00197	0.05634	0.00723
β	-0.00198	-0.00188	-0.00188	0.01714	-0.00191	-0.00191