Tactical Asset Allocation: Putting the Pieces Together

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Contents

Introduction

Overview

- Cash-portfolio with futures strategy.
- Long/short positions are allowed.
- Should cover the major bond and equity markets.
- Should include a protection mechanism.
- Fully-hedged against currency risk.

Introduction

The Pieces and Packages

- Forecasting model, *e.g.* `vars` and `urca`
- Risk model, *e.q.* `fExtremes` and `QRMlib`
- Linear integer program, *e.q.* `glpk`

Data Analysis

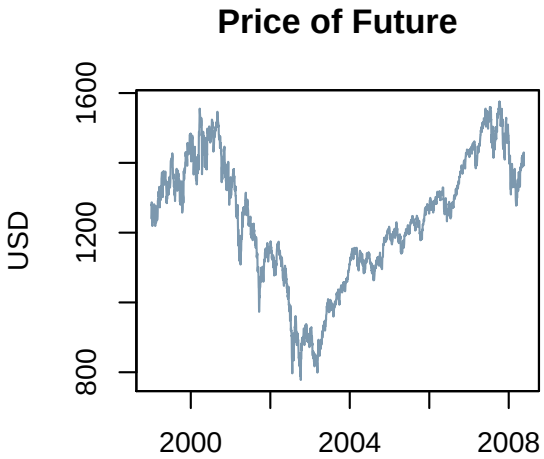
Data

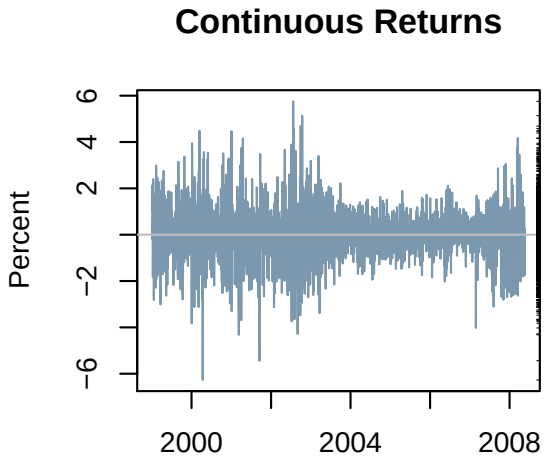
Continuous settlement (Wednesdays' closing prices) of:

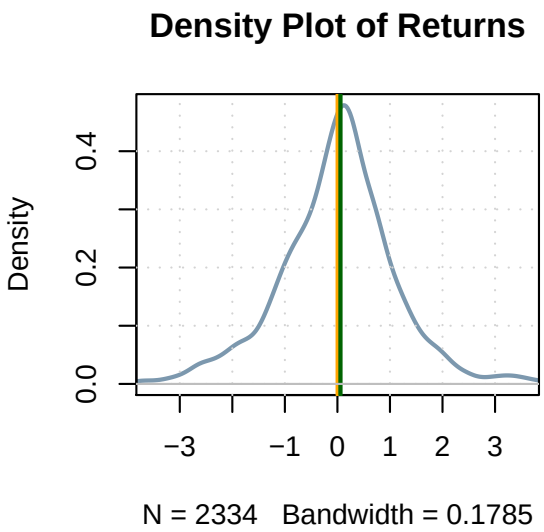
Exchange : Instrument	DS-Mnemonic	Multiple
	Equity	
CME: S&P 500	ISPCS00	250 USD / IP
EUREX: DJ EURO STOXX 50	GEXCS00	10 EUR / IP
LIFFE: FTSE 250	LSYCS00	10 GBP / IP
OSX: NIKKEI 225	ONACS00	1000 JPY / IP
	Bond	
CBT: 10 YEAR US T-NOTE	CTYCS00	1000 USD / 100 BP
EUREX: EURO BUND	GGECS00	1000 EUR / 100 BP
LIFFE: LONG GILT	LIGCS00	1000 GBP / 100 BP
TSE: 10 YEAR T-BOND	JGBCS00	1000000 JPY / 100 BP

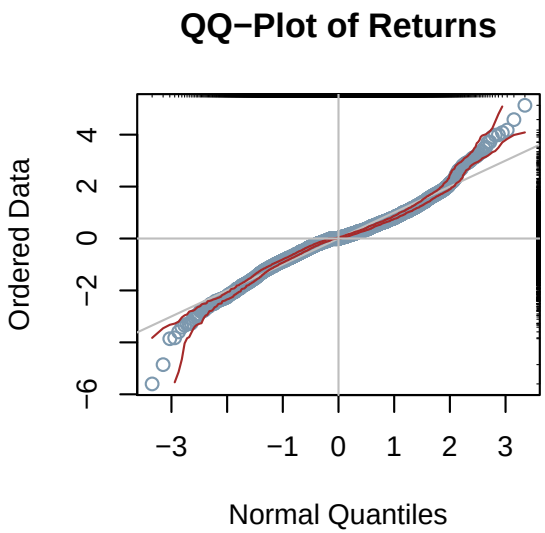
Data Analysis

U.S. Equity



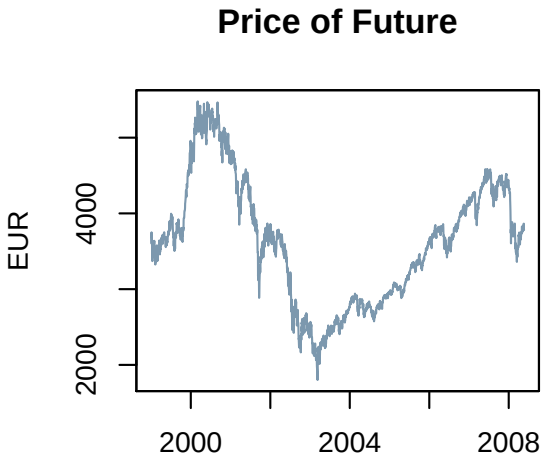


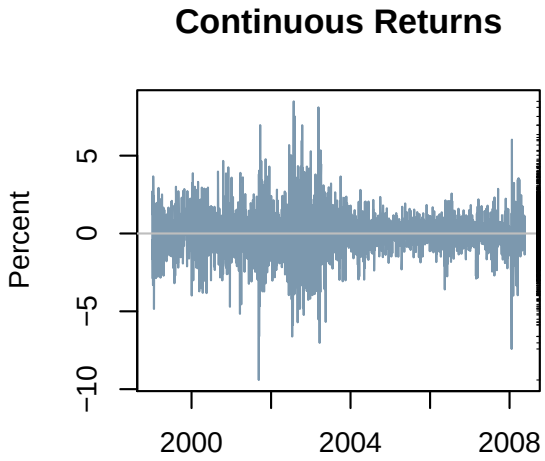


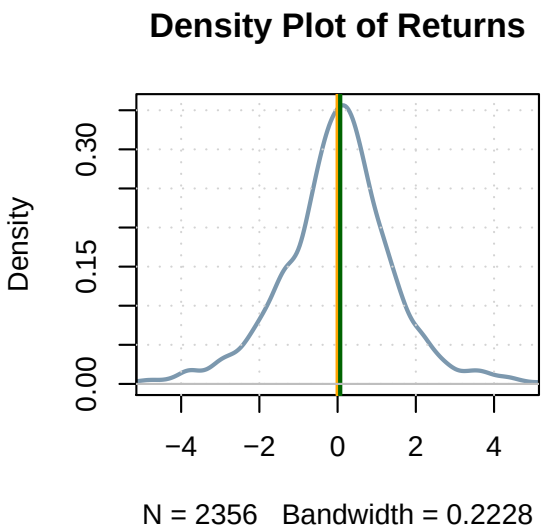


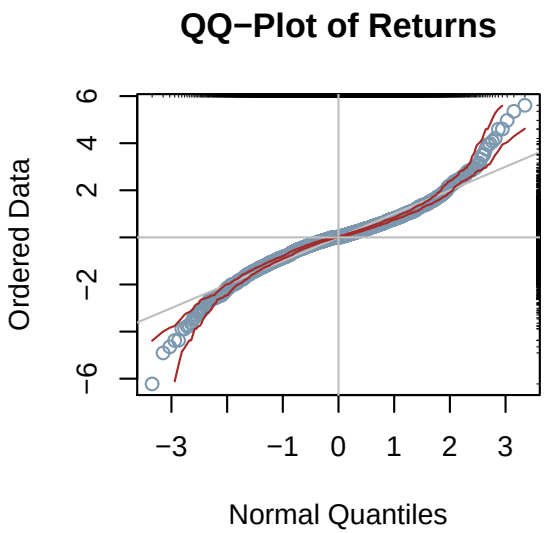
Data Analysis

Eurobloc Equity



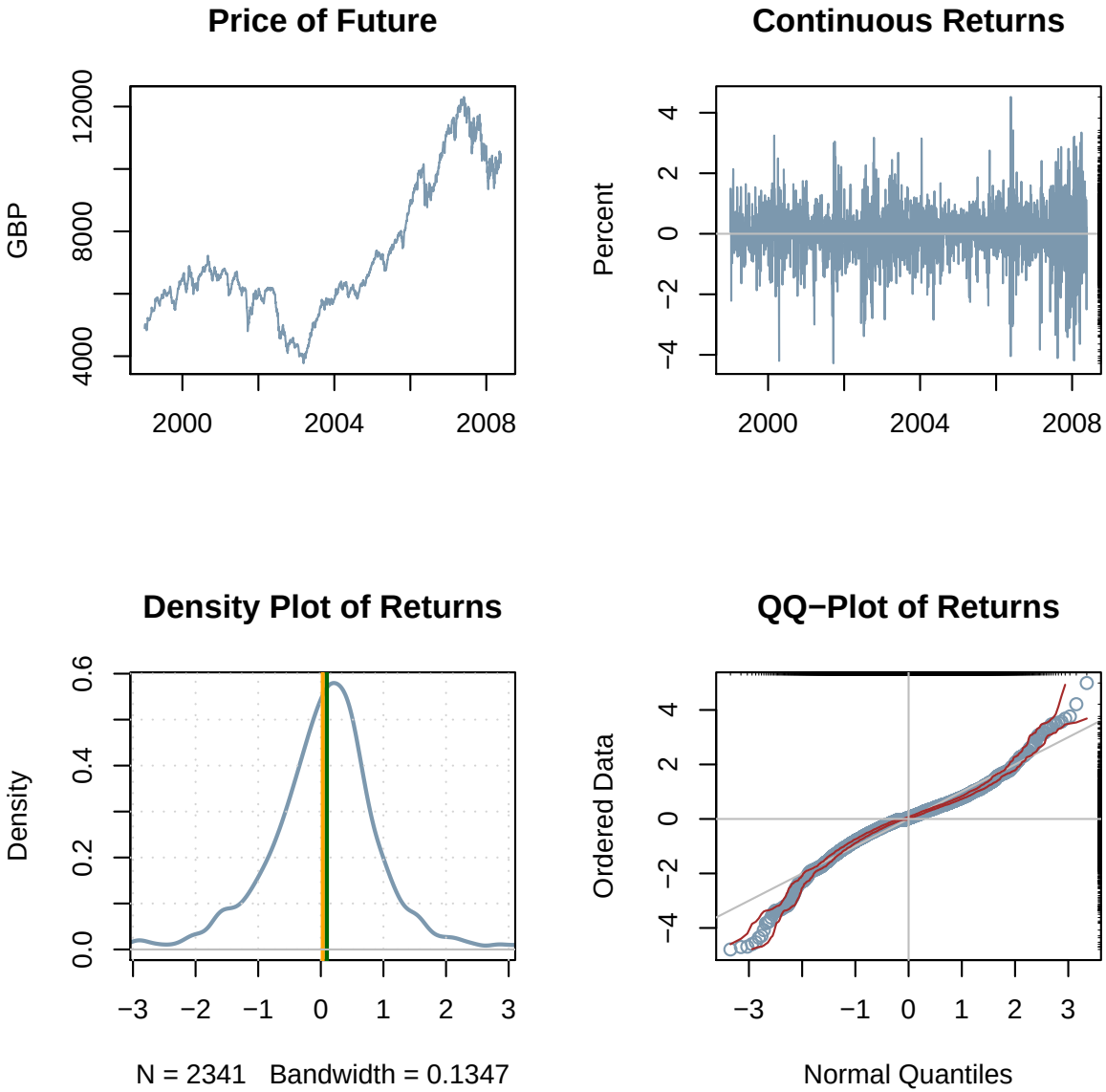






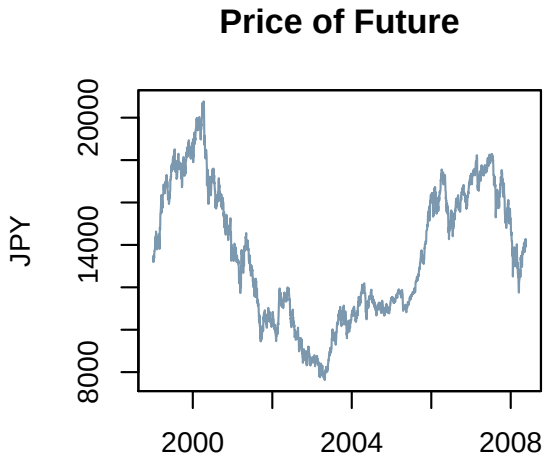
Data Analysis

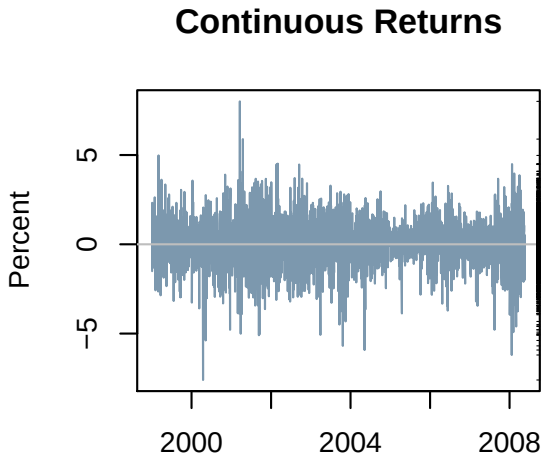
U.K. Equity

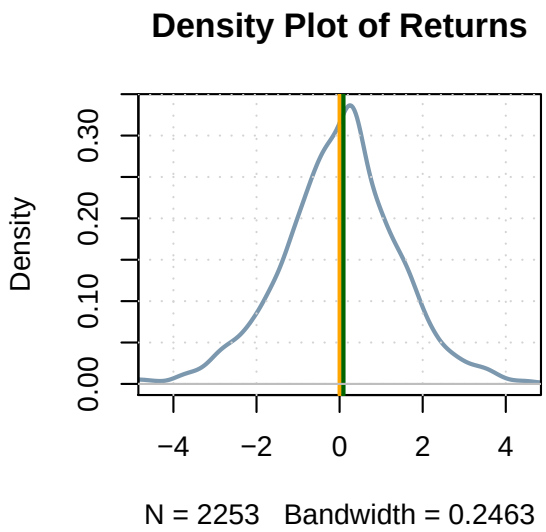


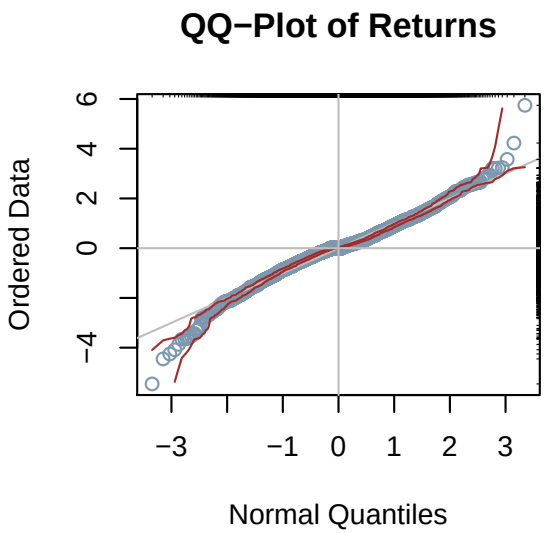
Data Analysis

Japan Equity



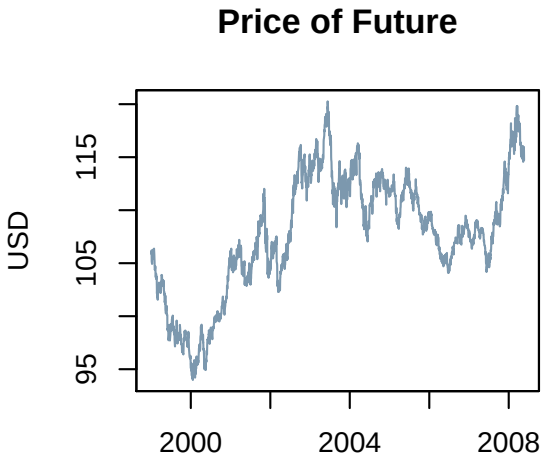


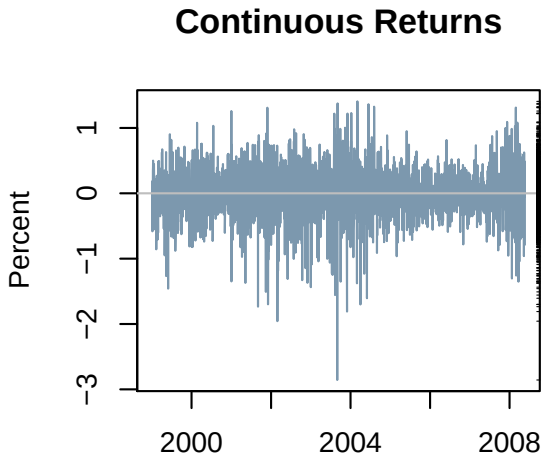


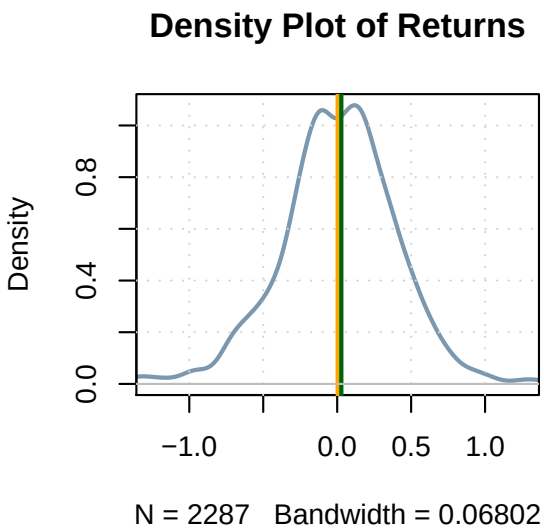


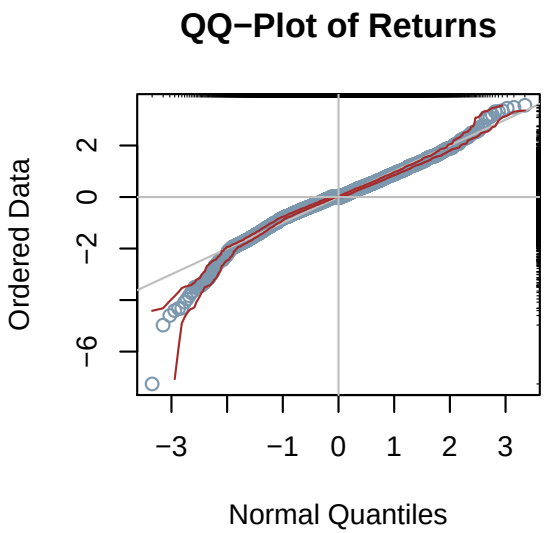
Data Analysis

U.S. Bond







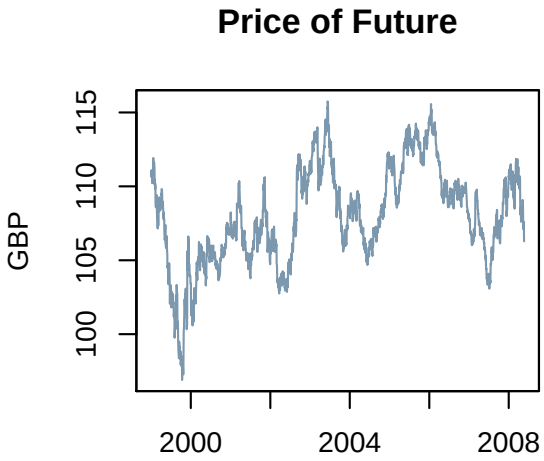


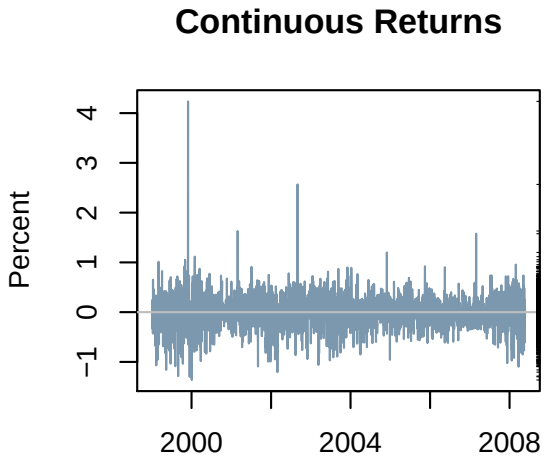
Data Analysis

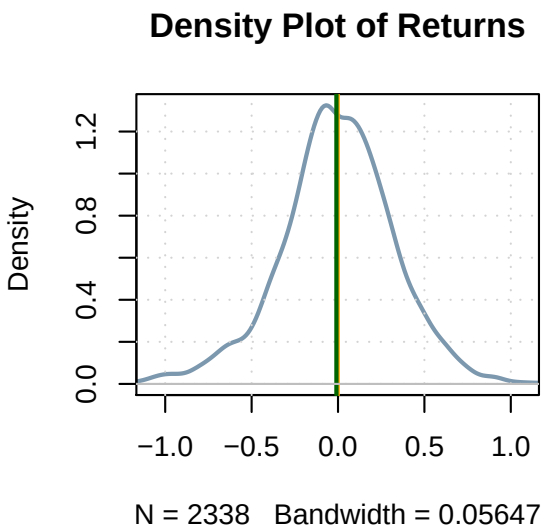
Eurobloc Bond

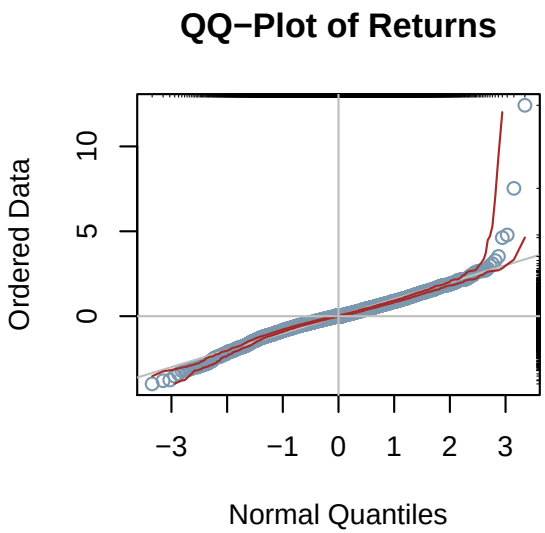
Data Analysis

U.K. Bond



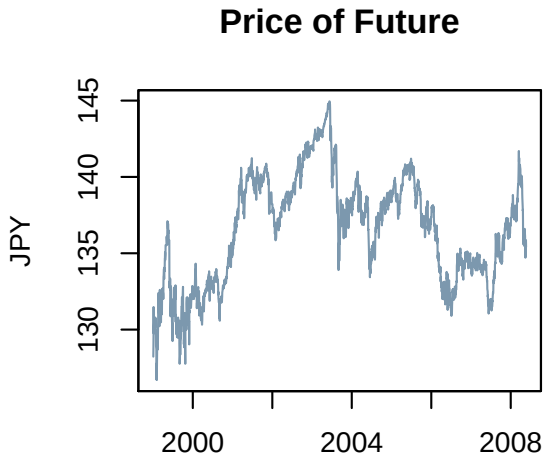


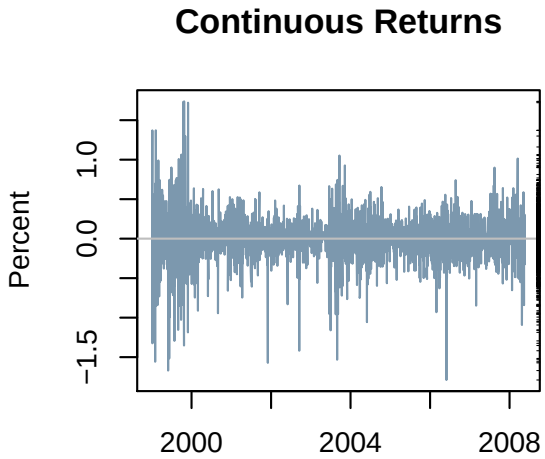


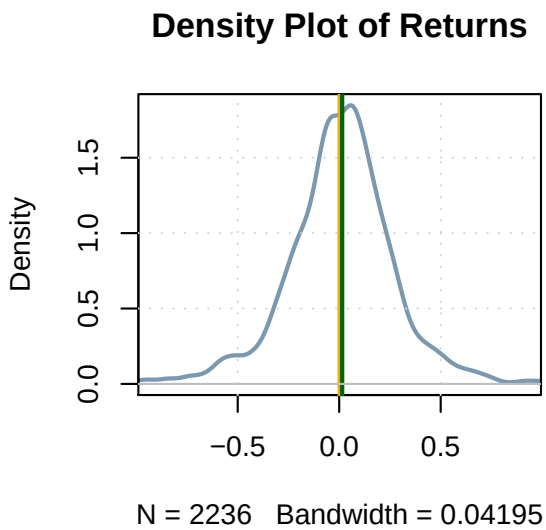


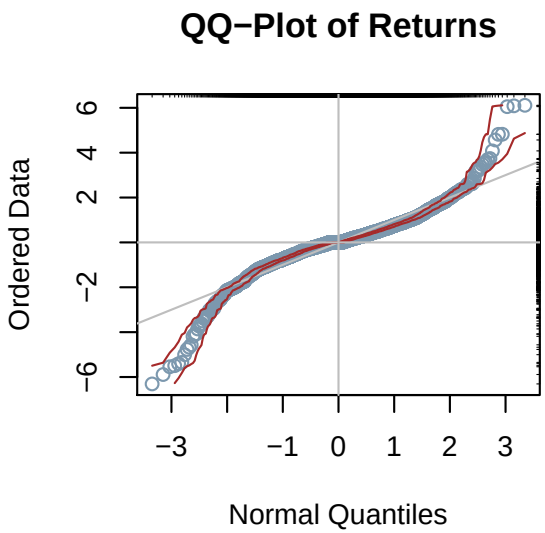
Data Analysis

Japan Bond









Forecasting Model

Vector Error-correction Model (VECM)

- VECM specified in transitory form with one lagged difference.
- Logarithmic transformation applied.
- Full sample period from 1999-01-06 until 2008-04-30.
- Pseudo ex ante forecasts starting 2002-11-06.
- One-step ahead forecasts are obtained from implied level-VAR.

Forecasting Model

ERS Tests, Equities

variable	statistic	1%	5%	10%	lags
U.S. level	−1.39	−3.48	−2.89	−2.57	8
U.S. difference	−5.57	−2.57	−1.94	−1.62	8
Eurobloc level	−1.27	−3.48	−2.89	−2.57	8
Eurobloc difference	−5.45	−2.57	−1.94	−1.62	8
U.K. level	−1.29	−3.48	−2.89	−2.57	8
U.K. difference	−13.50	−2.57	−1.94	−1.62	8
Japan level	−1.37	−3.48	−2.89	−2.57	8
Japan difference	−4.81	−2.57	−1.94	−1.62	8

Forecasting Model

ERS Tests, Bonds

variable	statistic	1%	5%	10%	lags
U.S. level	−1.98	−3.48	−2.89	−2.57	8
U.S. difference	−6.33	−2.57	−1.94	−1.62	8
Eurobloc level	−1.46	−3.48	−2.89	−2.57	8
Eurobloc difference	−15.57	−2.57	−1.94	−1.62	8
U.K. level	−2.25	−3.48	−2.89	−2.57	8
U.K. difference	−5.22	−2.57	−1.94	−1.62	8
Japan level	−1.54	−3.48	−2.89	−2.57	8
Japan difference	−3.35	−2.57	−1.94	−1.62	8

Forecasting Model

KPSS Tests, Equities

variable	statistic	1%	5%	10%	lags
U.S. level	5.49	0.216	0.146	0.119	8
U.S. difference	0.11	0.739	0.463	0.347	8
Eurobloc level	4.66	0.216	0.146	0.119	8
Eurobloc difference	0.14	0.739	0.463	0.347	8
U.K. level	5.51	0.216	0.146	0.119	8
U.K. difference	0.15	0.739	0.463	0.347	8
Japan level	5.40	0.216	0.146	0.119	8
Japan difference	0.13	0.739	0.463	0.347	8

Forecasting Model

KPSS Tests, Bonds

variable	statistic	1%	5%	10%	lags
U.S. level	3.73	0.216	0.146	0.119	8
U.S. difference	0.07	0.739	0.463	0.347	8
Eurobloc level	2.18	0.216	0.146	0.119	8
Eurobloc difference	0.13	0.739	0.463	0.347	8
U.K. level	1.45	0.216	0.146	0.119	8
U.K. difference	0.05	0.739	0.463	0.347	8
Japan level	4.21	0.216	0.146	0.119	8
Japan difference	0.12	0.739	0.463	0.347	8

Forecasting Model

Results of Trace Test

rank	statistic	10%	5%	1%
$r \leq 7$	0.39	6.50	8.18	11.65
$r \leq 6$	6.82	15.66	17.95	23.52
$r \leq 5$	17.95	28.71	31.52	37.22
$r \leq 4$	32.91	45.23	48.28	55.43
$r \leq 3$	54.48	66.49	70.60	78.87
$r \leq 2$	83.30	85.18	90.39	104.20
$r \leq 1$	123.52	118.99	124.25	136.06
$r = 0$	177.79	151.38	157.11	168.92

Conclusion: Cointegration rank of $r = 2$ cannot be rejected.

Risk Model

Settings and Quantitative Risk Measures

- Usage of expected shortfall (ES) numbers.
- Rolling window of 1000 observations per instrument.
- Estimates based on EVT (POT-method).
- Backtest period from 04-11-2002 to 29-04-2008.
- KISS: No combined GARCH & ES forecast.
- Instead, ES of last trading day used as forecast for today's ES.

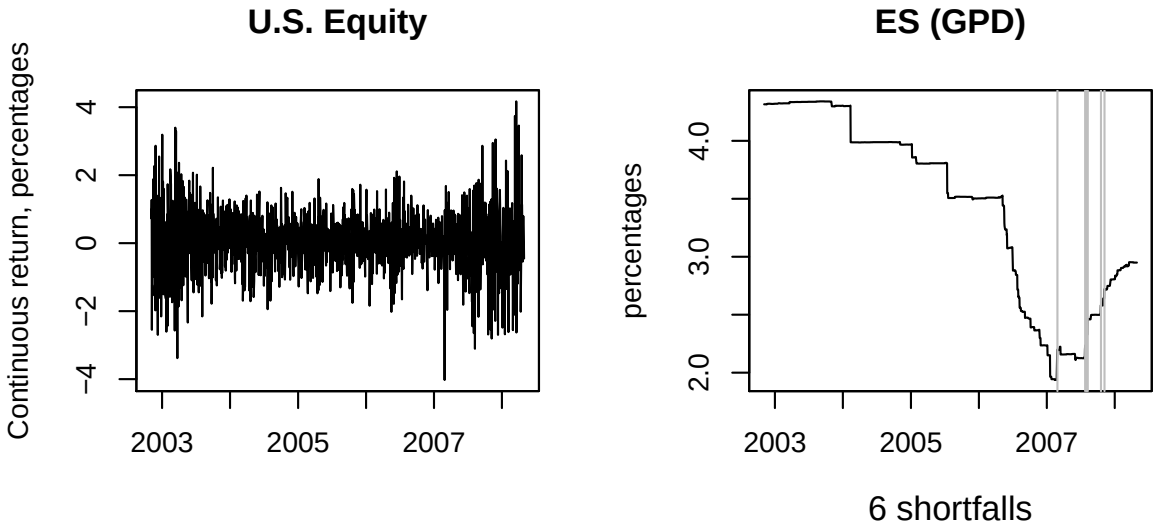
Risk Model

Overview Long-Positions, 99%-Level

Instrument	Expected	VaR-GPD	ES-GPD	VaR-Norm
Equity				
U.S.	14	20	6	23
Eurobloc	14	12	4	18
U.K.	14	21	9	36
Japan	14	18	7	28
Bonds				
U.S.	14	17	6	28
Eurobloc	14	13	6	25
U.K.	14	13	4	21
Japan	14	12	3	25

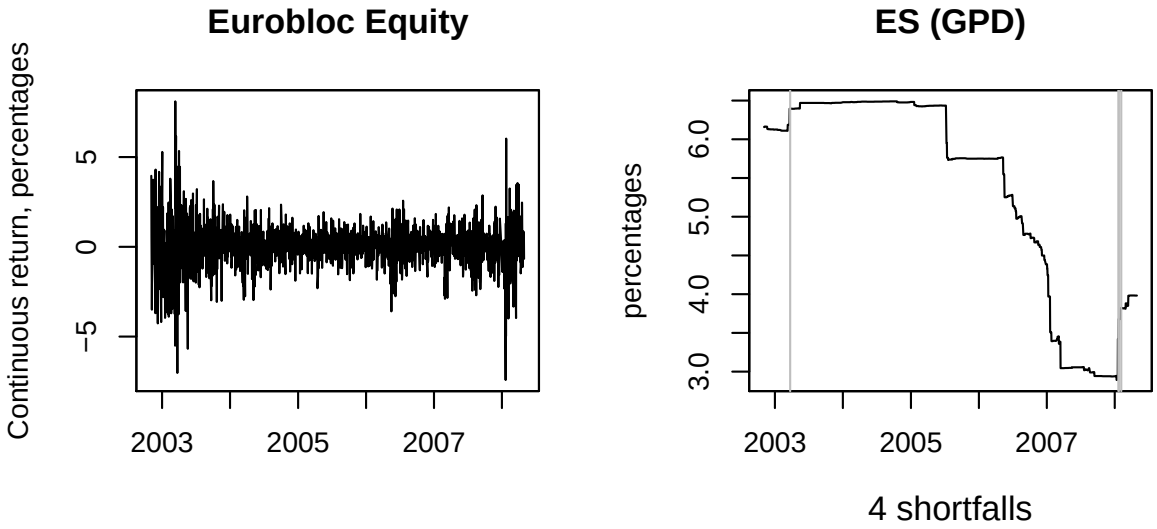
Risk Model

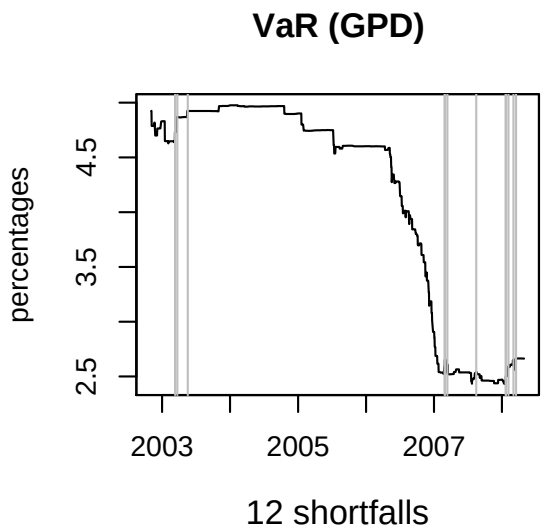
U.S. Equity: VaR & ES (Long, 99%)

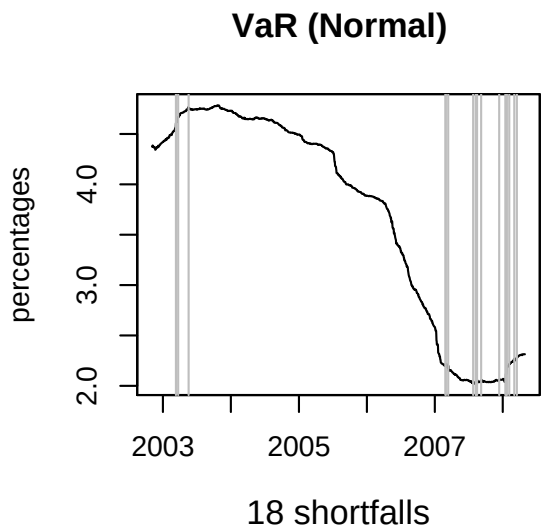


Risk Model

Eurobloc Equity: VaR & ES (Long, 99%)

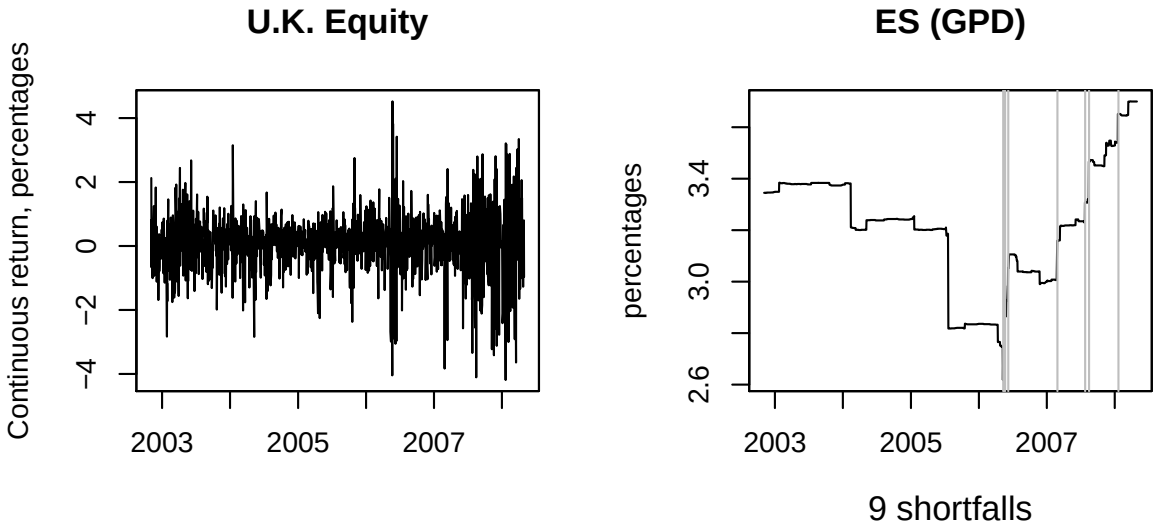


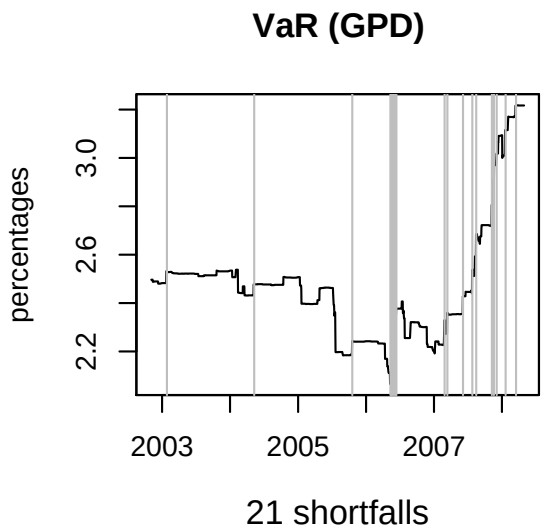


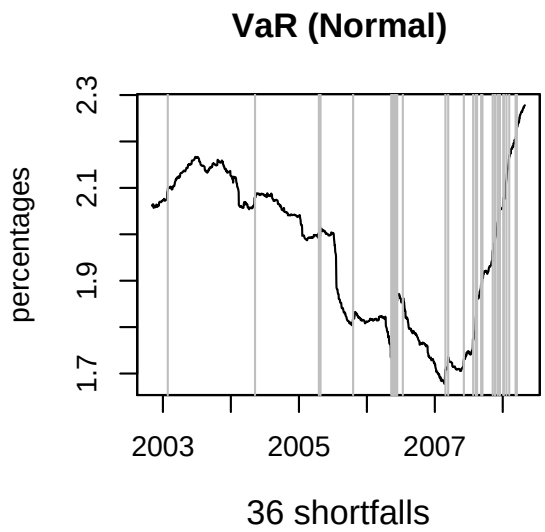


Risk Model

U.K. Equity: VaR & ES (Long, 99%)

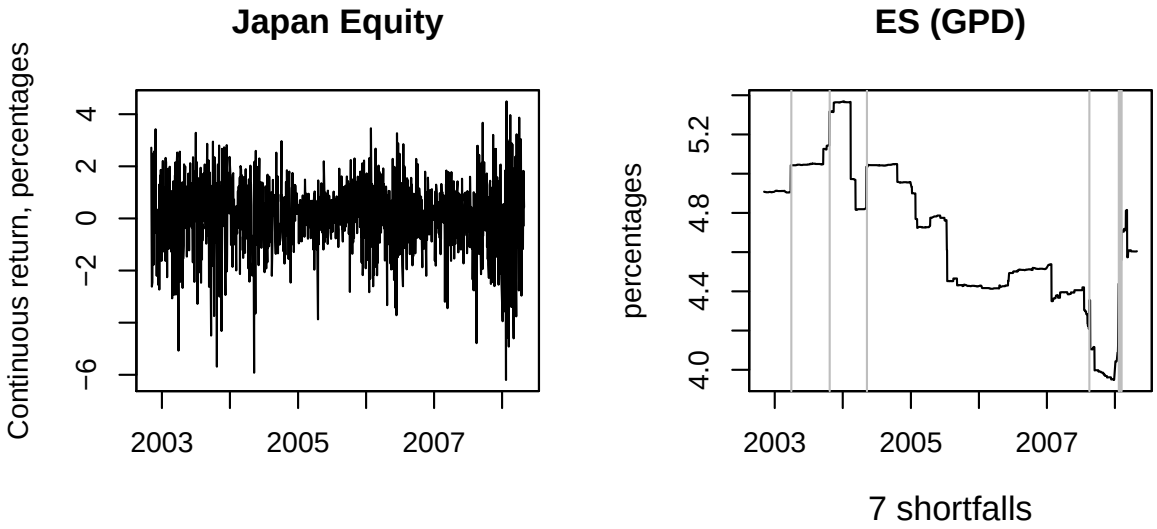






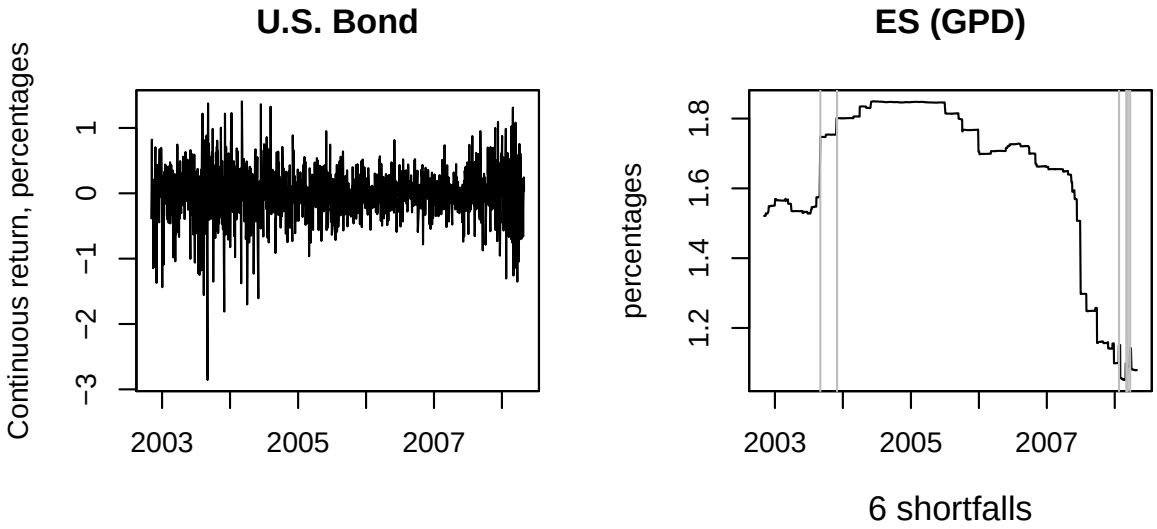
Risk Model

Japan Equity: VaR & ES (Long, 99%)



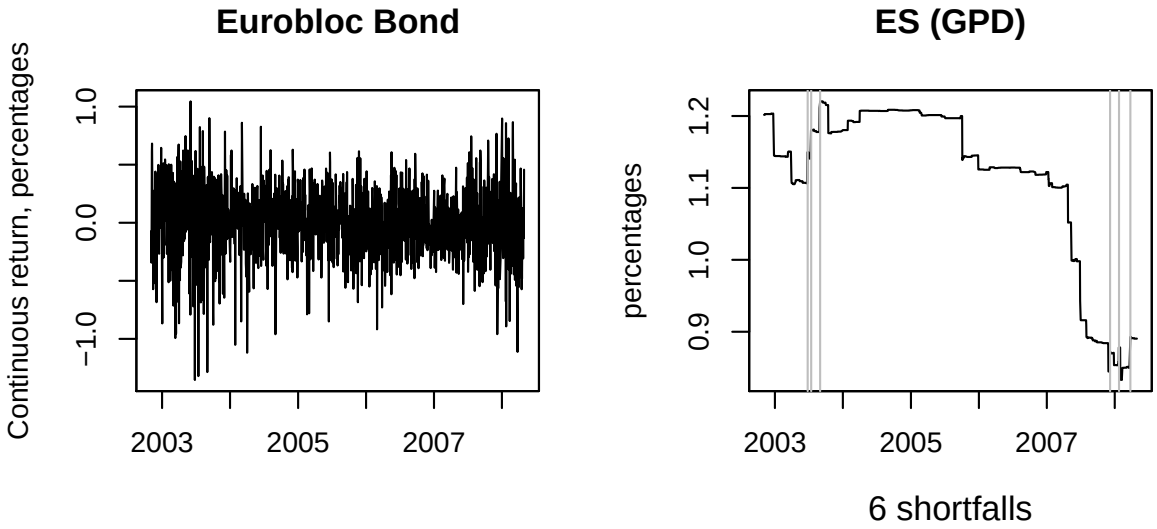
Risk Model

U.S. Bond: VaR & ES (Long, 99%)



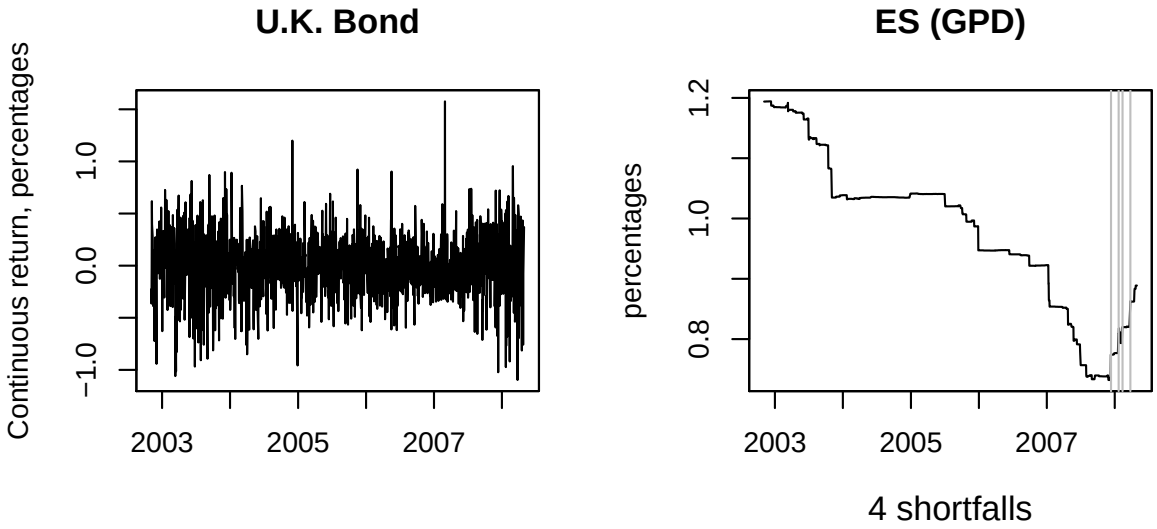
Risk Model

Eurobloc Bond: VaR & ES (Long, 99%)



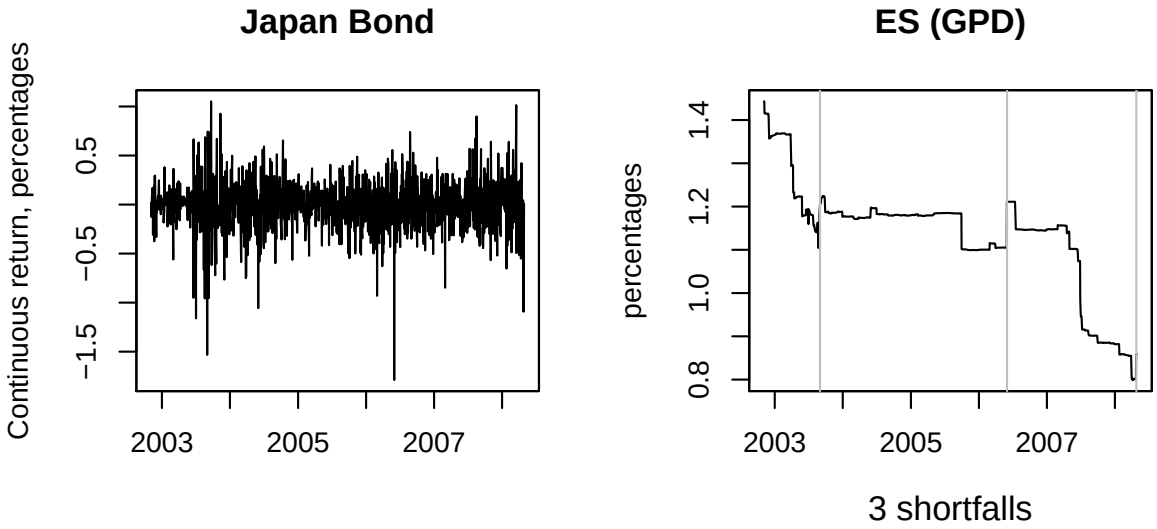
Risk Model

U.K. Bond: VaR & ES (Long, 99%)



Risk Model

Japan Bond: VaR & ES (Long, 99%)



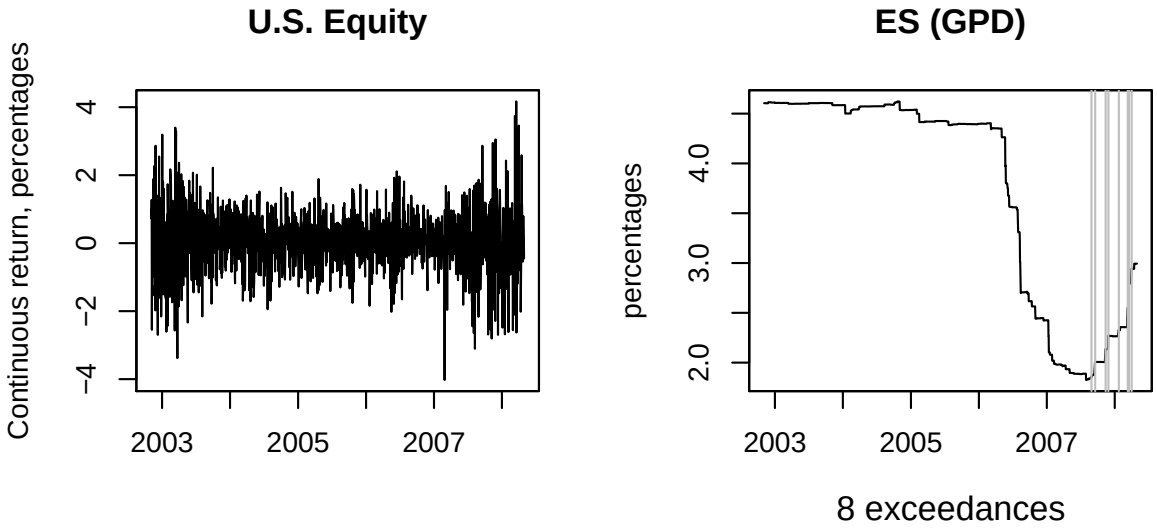
Risk Model

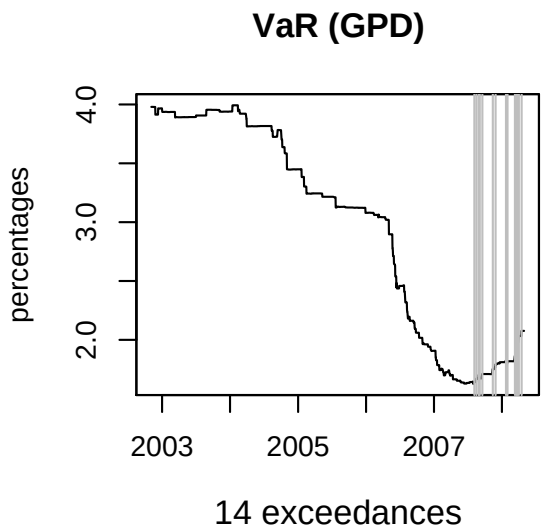
Overview Short-Positions, 99%-Level

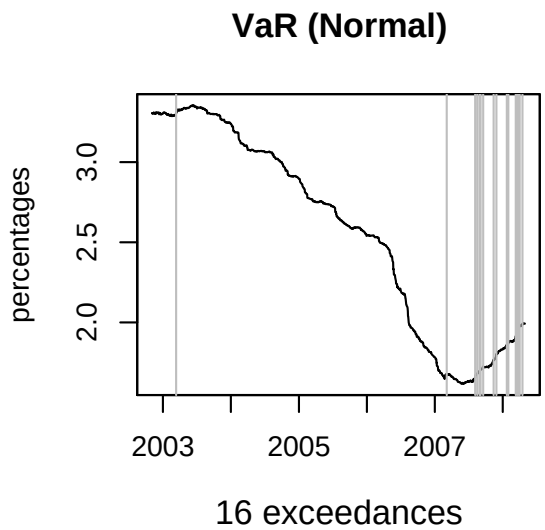
Instrument	Expected	VaR-GPD	ES-GPD	VaR-Norm
Equity				
U.S.	14	14	8	16
Eurobloc	14	13	7	13
U.K.	14	24	6	30
Japan	14	14	5	14
Bonds				
U.S.	14	21	8	18
Eurobloc	14	19	9	16
U.K.	14	14	3	13
Japan	14	16	5	18

Risk Model

U.S. Equity: VaR & ES (Short, 99%)

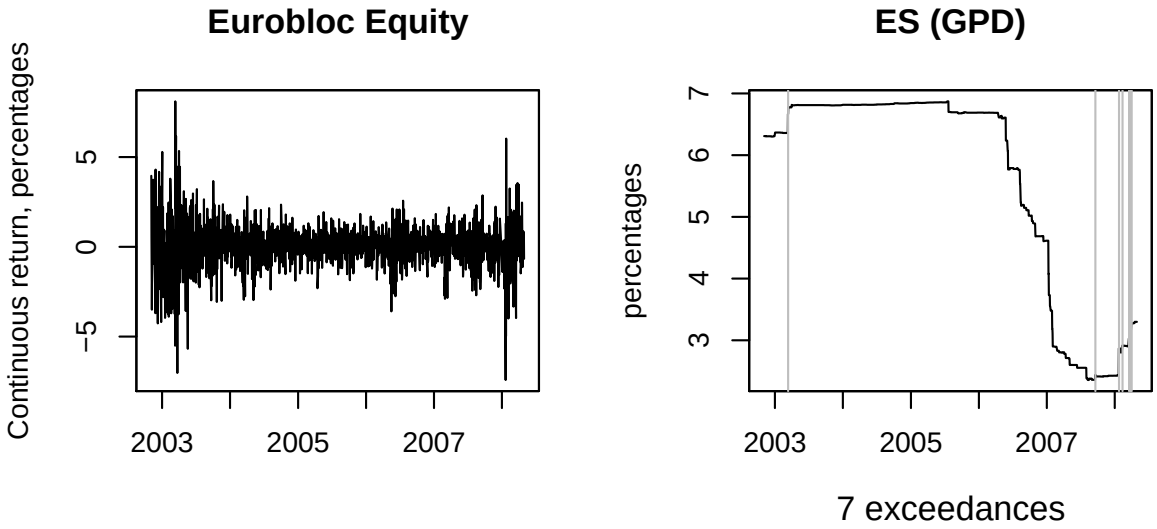






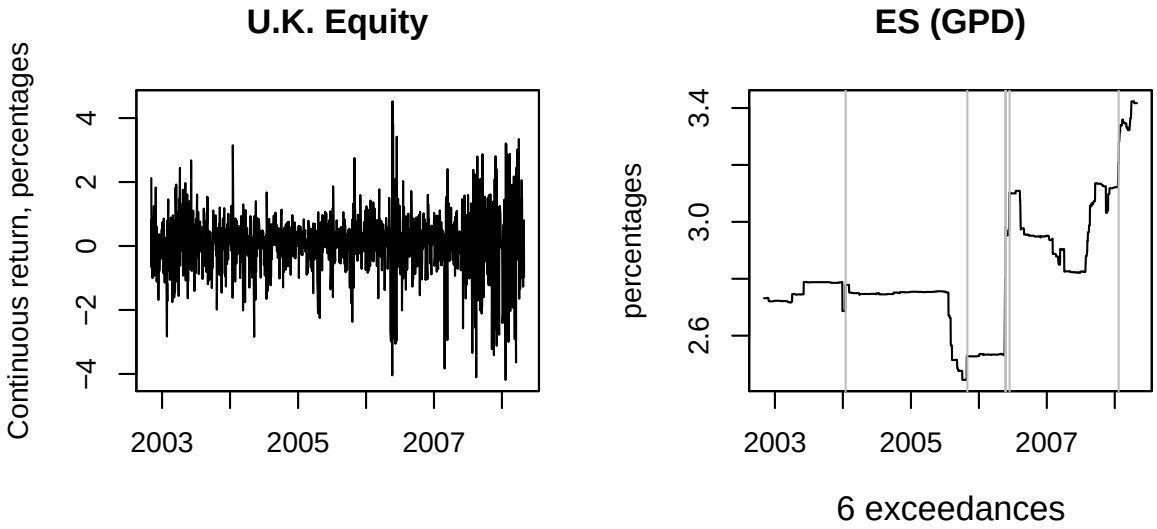
Risk Model

Eurobloc Equity: VaR & ES (Short, 99%)



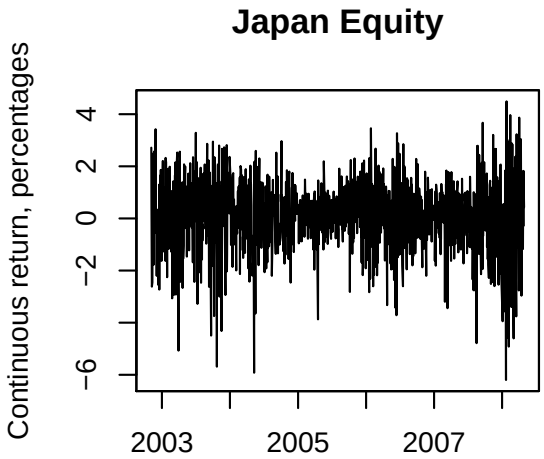
Risk Model

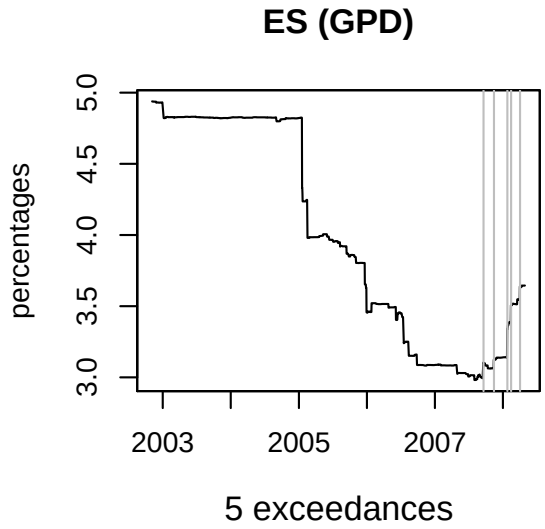
U.K. Equity: VaR & ES (Short, 99%)

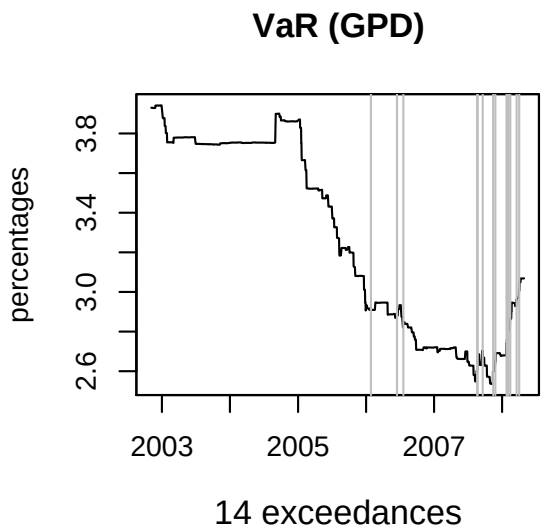


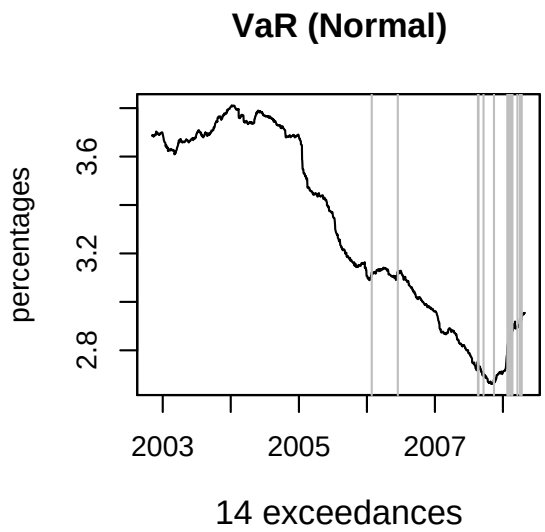
Risk Model

Japan Equity: VaR & ES (Short, 99%)



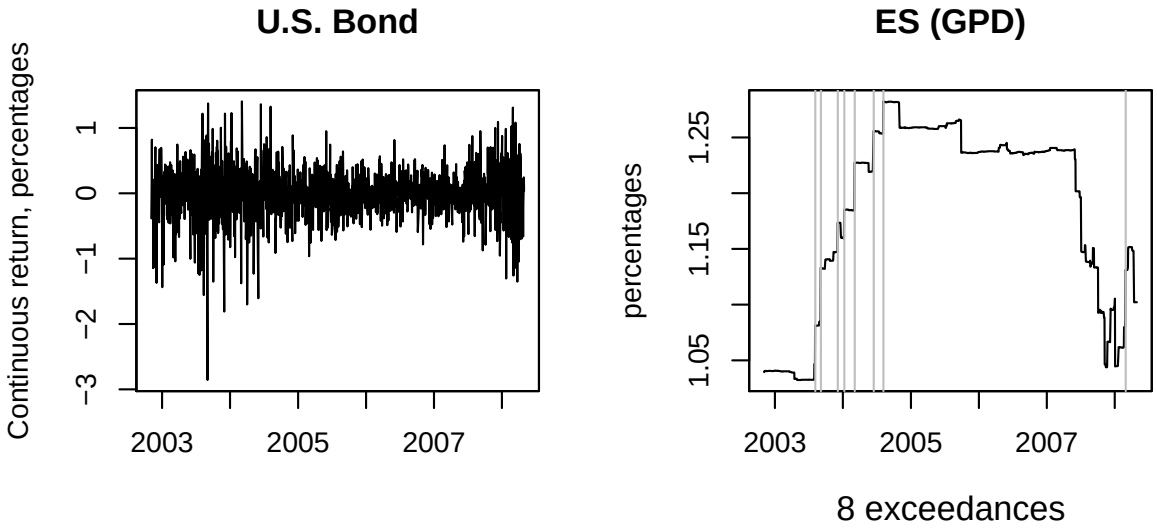






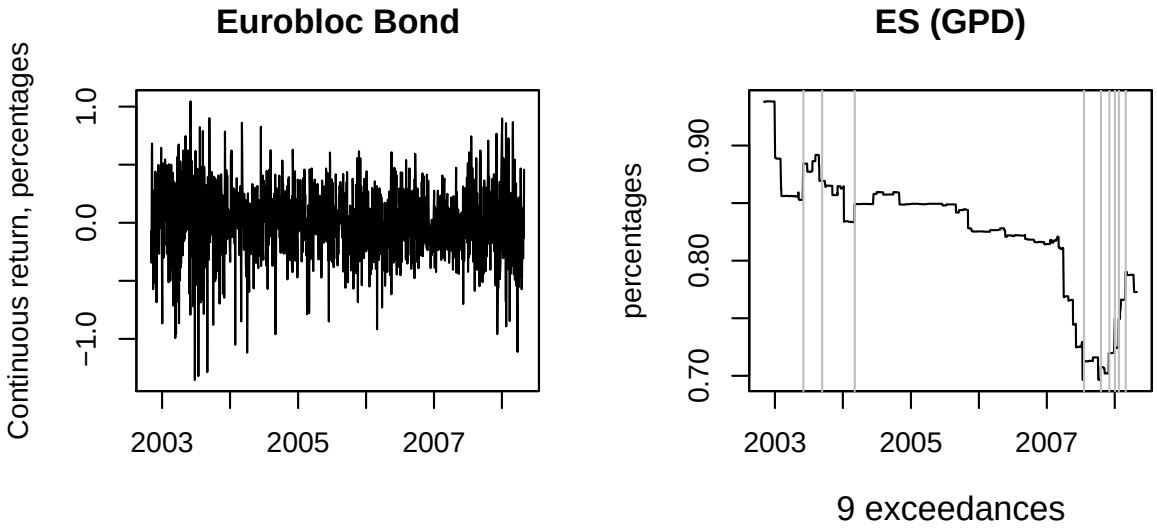
Risk Model

U.S. Bond: VaR & ES (Short, 99%)



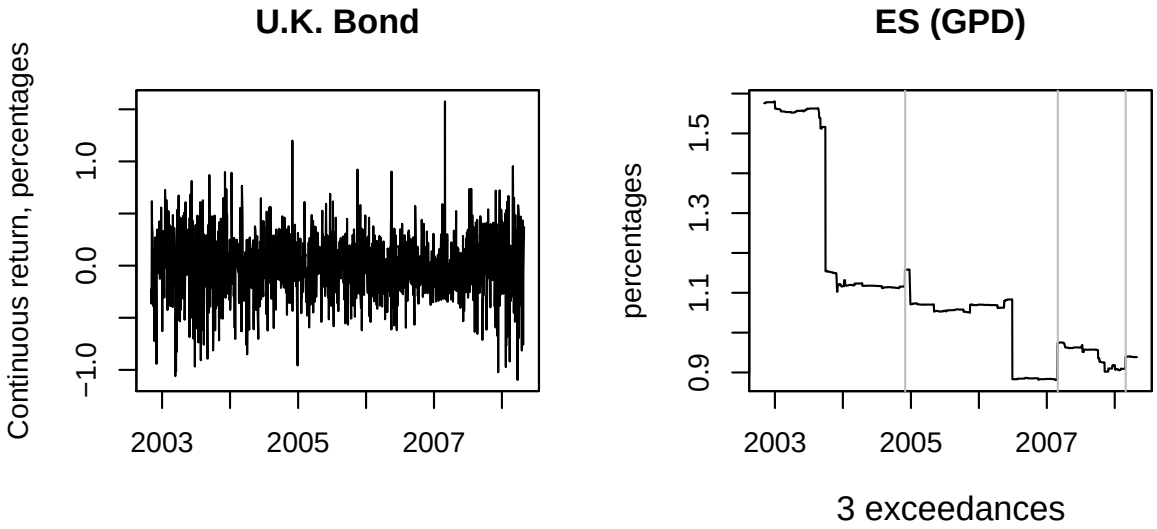
Risk Model

Eurobloc Bond: VaR & ES (Short, 99%)



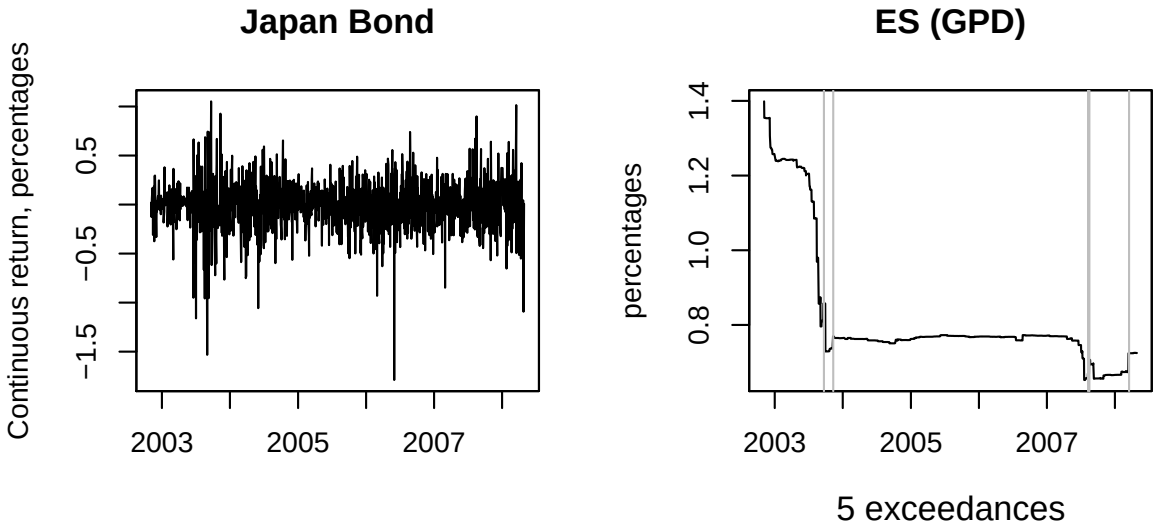
Risk Model

U.K. Bond: VaR & ES (Short, 99%)



Risk Model

Japan Bond: VaR & ES (Short, 99%)



Linear integer program

Target function

Maximize:

$$z = \sum_{i=1}^{n} |\Delta p_i^f| m_i x_i \ , \tag{1}$$

- whereby $|\Delta p_i^f|$ is the absolute expected price change of the i-th future contract, m_i is the corresponding multiple and x_i is the integer number of contracts to buy or sell.
- The expected price changes are denominated in Euro.

Linear integer program

Restrictions, I

- Budget:

$$w \geq \sum_{i=1}^{n} p_i m_i x_i \ . \tag{2}$$

whereby w is the portfolio wealth.

- Buffer:

$$p \geq \sum_{i=1}^{n} p_i m_i r_i x_i \ , \tag{3}$$

whereby p assigns the risk buffer and r_i is the risk factor.

- Equity share:

$$qa_1 \leq \frac{1}{w} \sum_{j=1}^{n_{equity}} p_j m_j x_j \leq qa_2 \ , \tag{4}$$

whereby qa_1 and qa_2 are the equity bounds.

Linear integer program

Restrictions, II

- Bond share:

$$qr_1 \leq \frac{1}{w} \sum_{j=1}^{n_{bonds}} p_j m_j x_j \leq qr_2 \tag{5}$$

  whereby qr_1 and qr_2 are the fixed income bounds.

- Shorts:

$$qs \geq \frac{1}{w} \sum_{j=1}^{n_{short}} p_j m_j x_j \ , \tag{6}$$

  whereby qs is the upper bound on short positions.

Simulated Portfolio

Assumptions and sample, I

- Begin of simulation: 2002-10-30.
- End of simulation: 2008-04-23.
- Risk-free rate: 1-week Euribor.
- Usage of 99% ES-rate derived from GPD-distribution (POT-method).
- Scaling of daily ES by $\sqrt{7}$.
- No transaction costs and fully hedged.

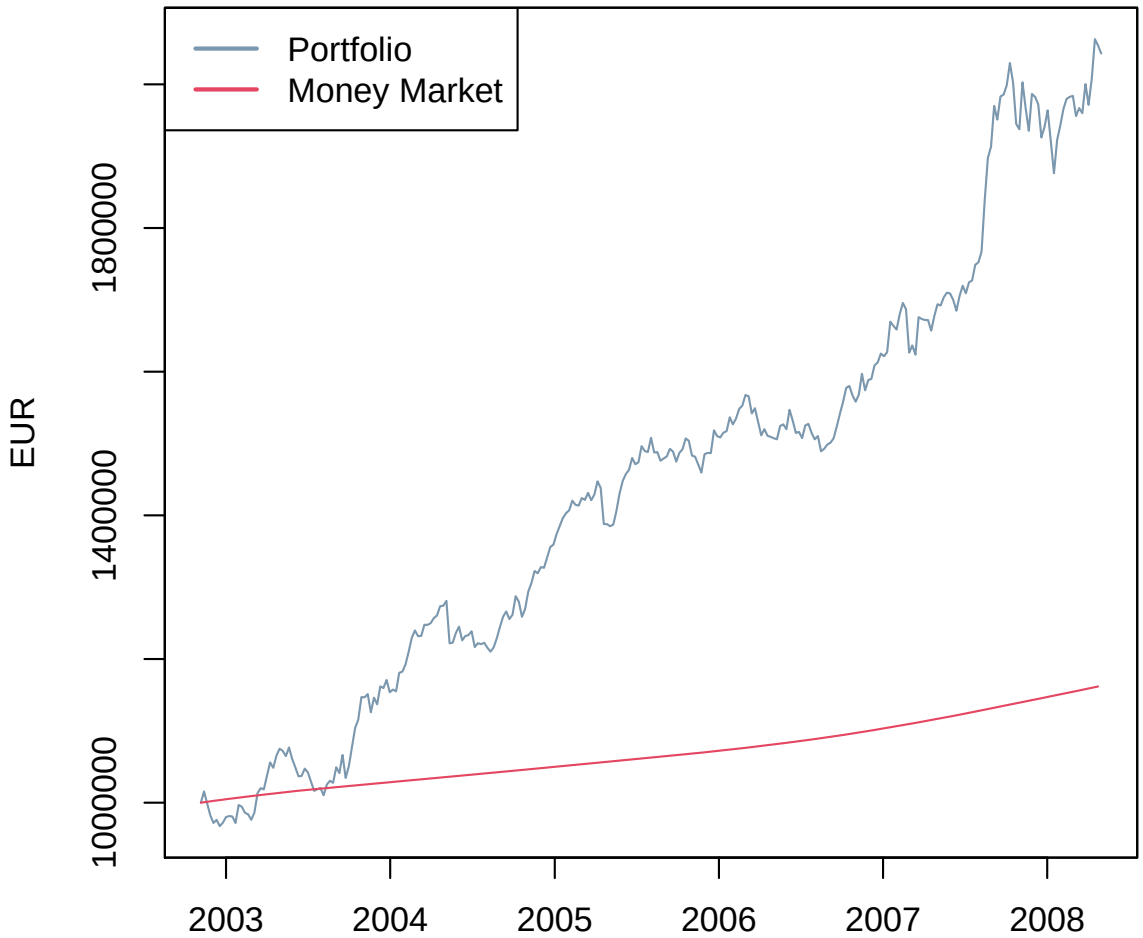
Simulated Portfolio

Assumptions and sample, II

- Initial wealth, w, 1,000,000 Euro.
- Risk buffer: 90% of the highest wealth amount (high-watermark).
- Equity share between 10% and 90% of wealth.
- Bonds share between 10% and 90%.
- Maximal amount of short positions as high as 50% of wealth.
- Only trade if expected return is greater than 200 BP above 1 week risk-free rate.

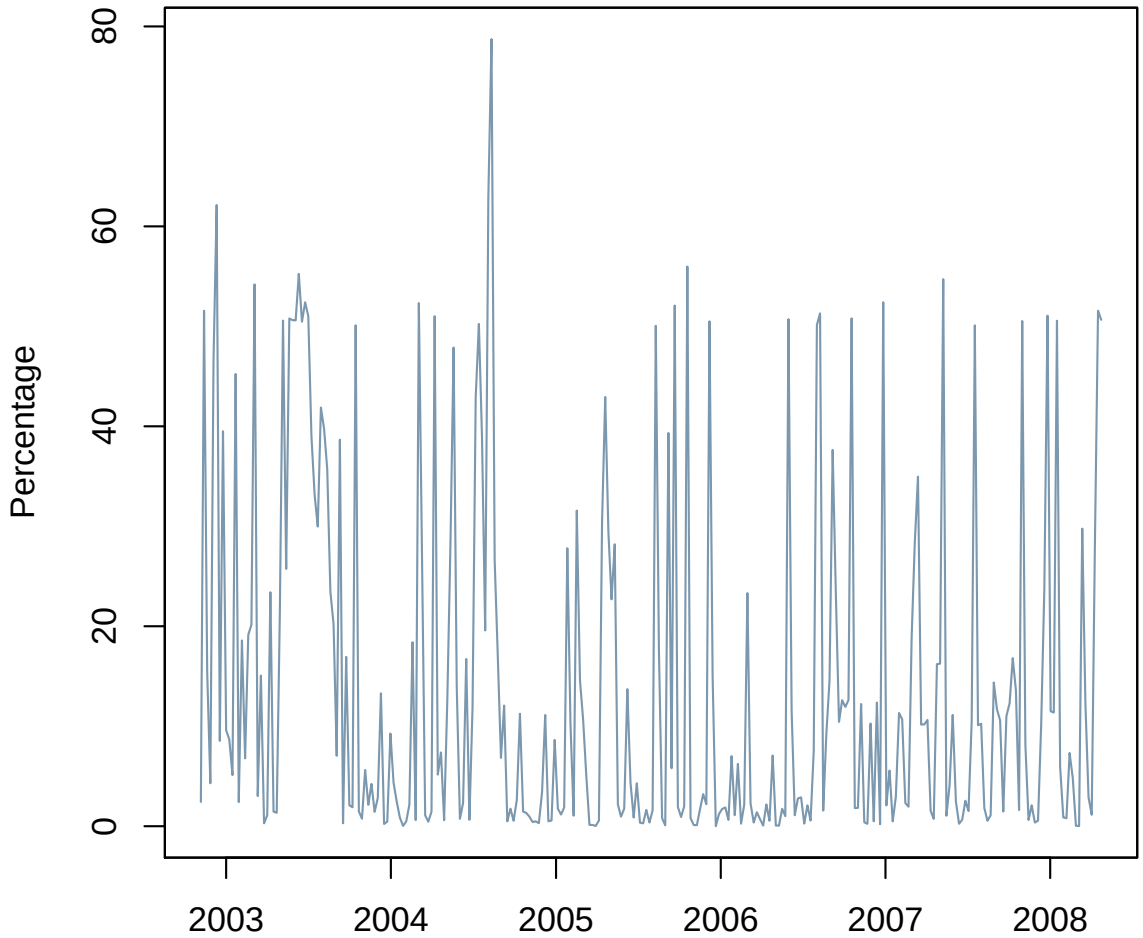
Simulated Portfolio

Portfolio vs. Cash



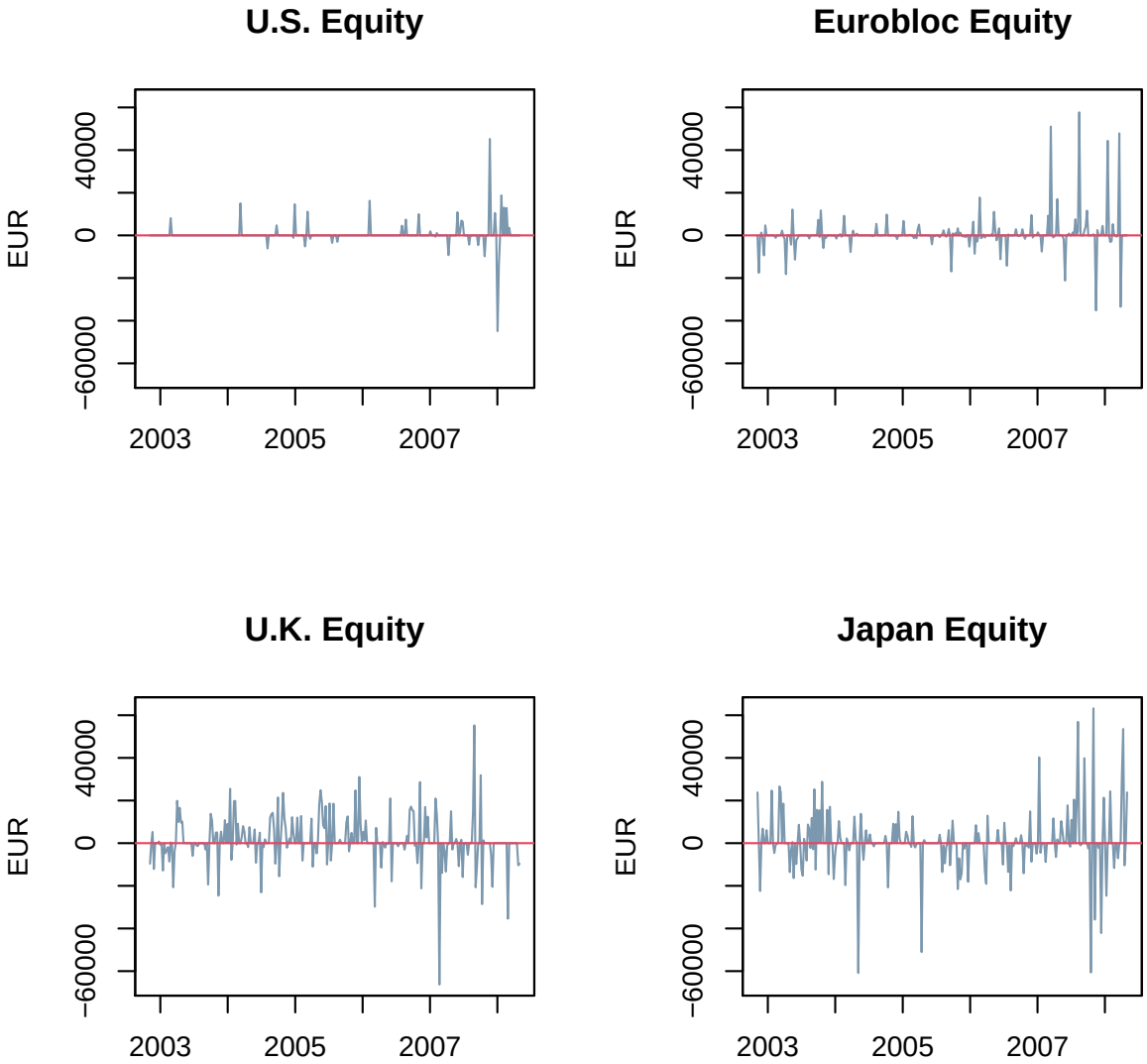
Simulated Portfolio

Cash rate



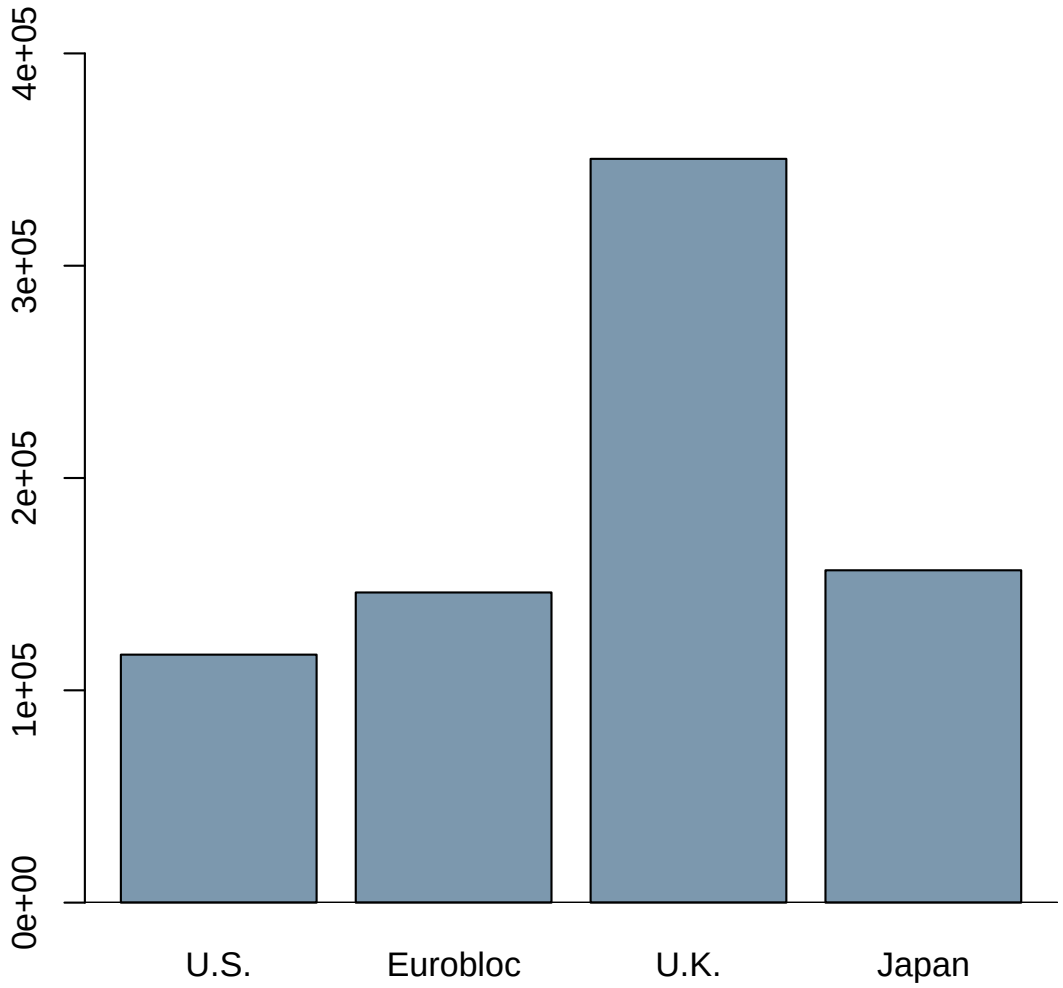
Simulated Portfolio

Equity Contribution



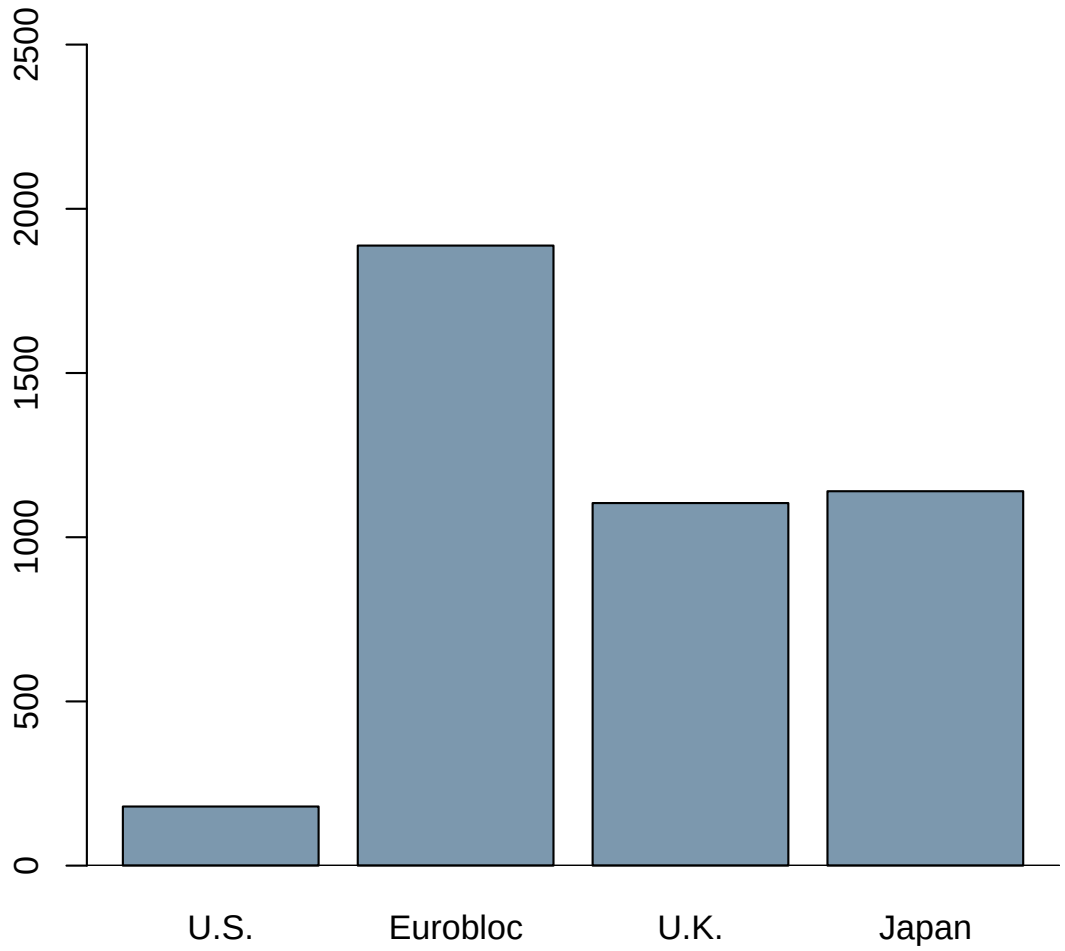
Simulated Portfolio

Cumulated Contribution from Equity Futures



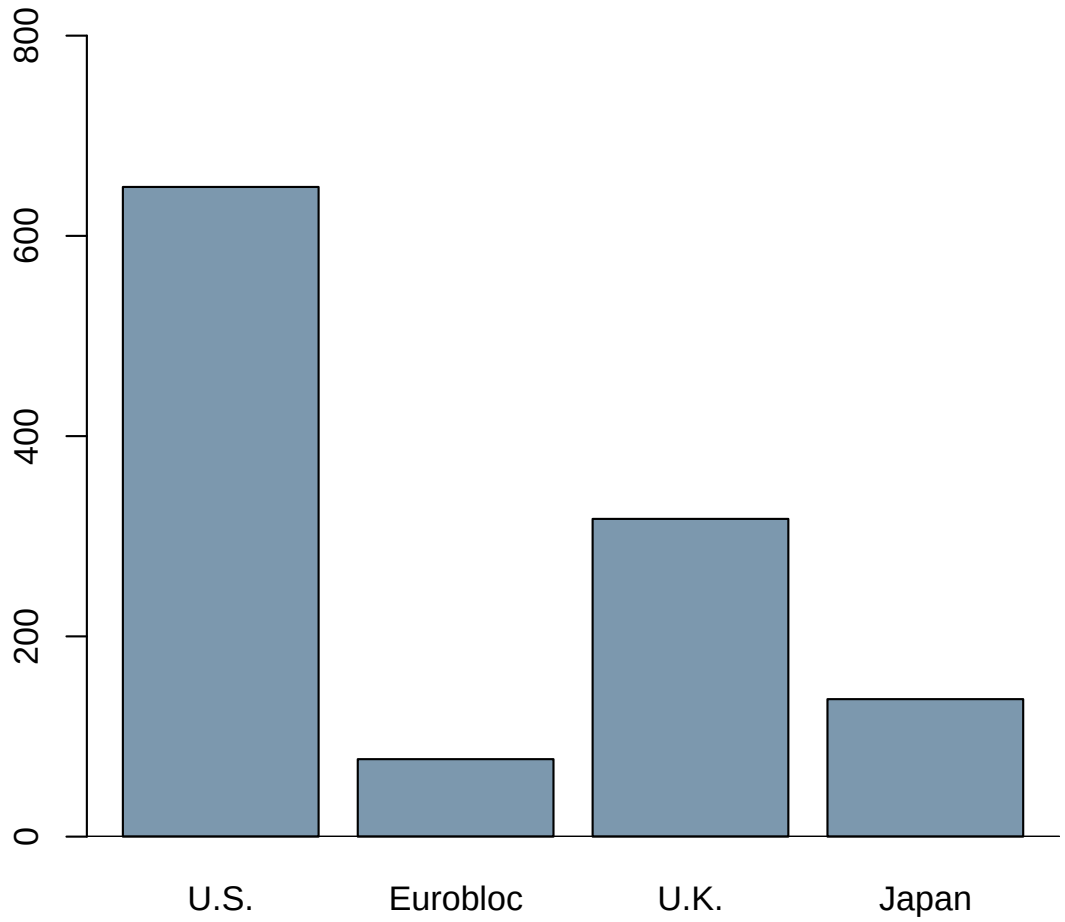
Simulated Portfolio

Number of Traded Equity Futures



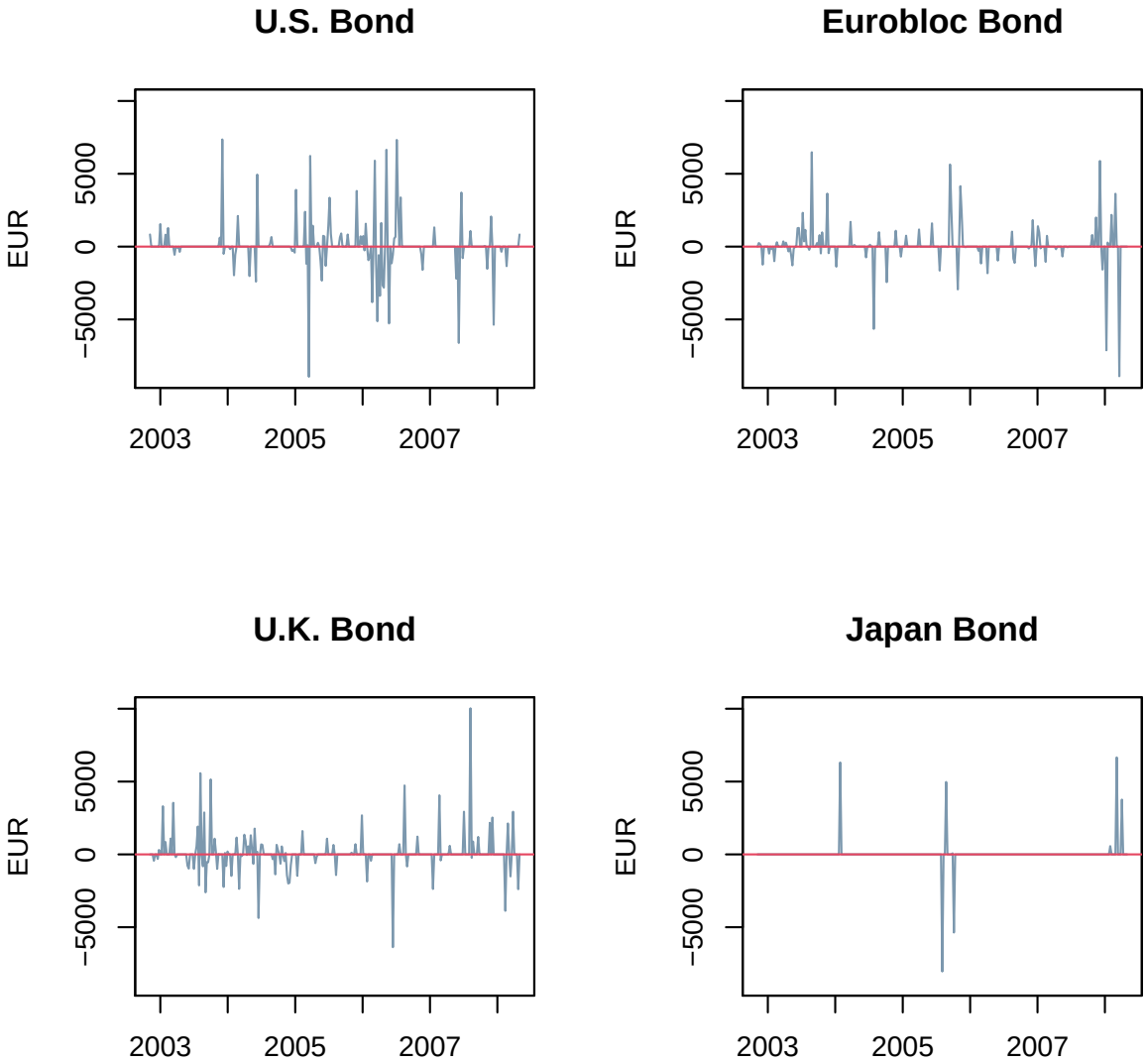
Simulated Portfolio

Average Return from Equity Futures



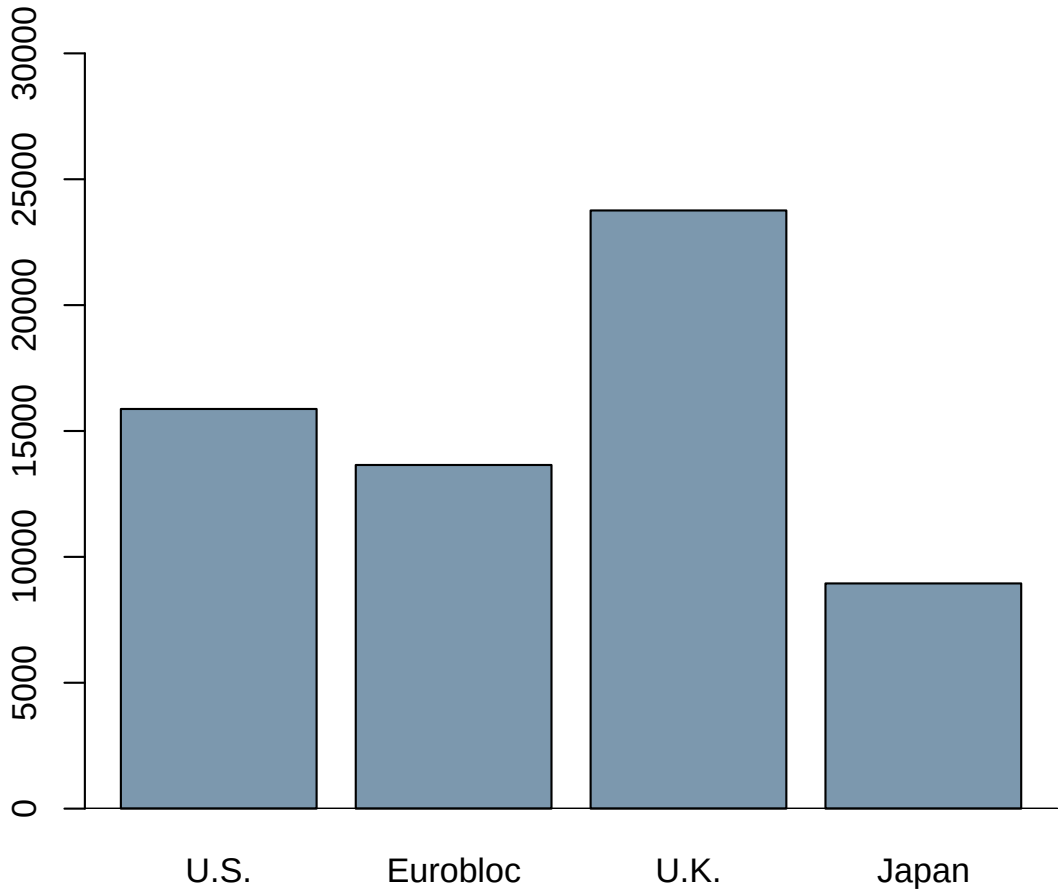
Simulated Portfolio

Bond Contribution



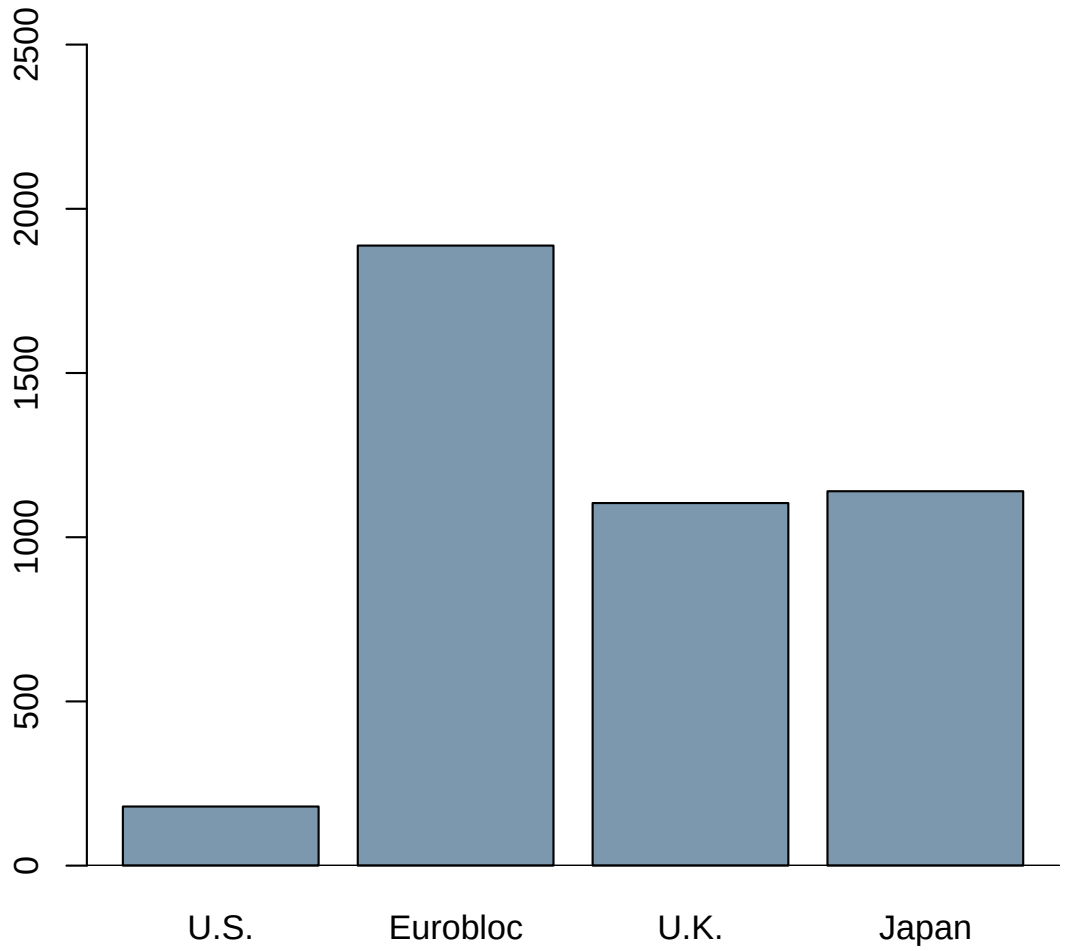
Simulated Portfolio

Cumulated Contribution from Bond Futures



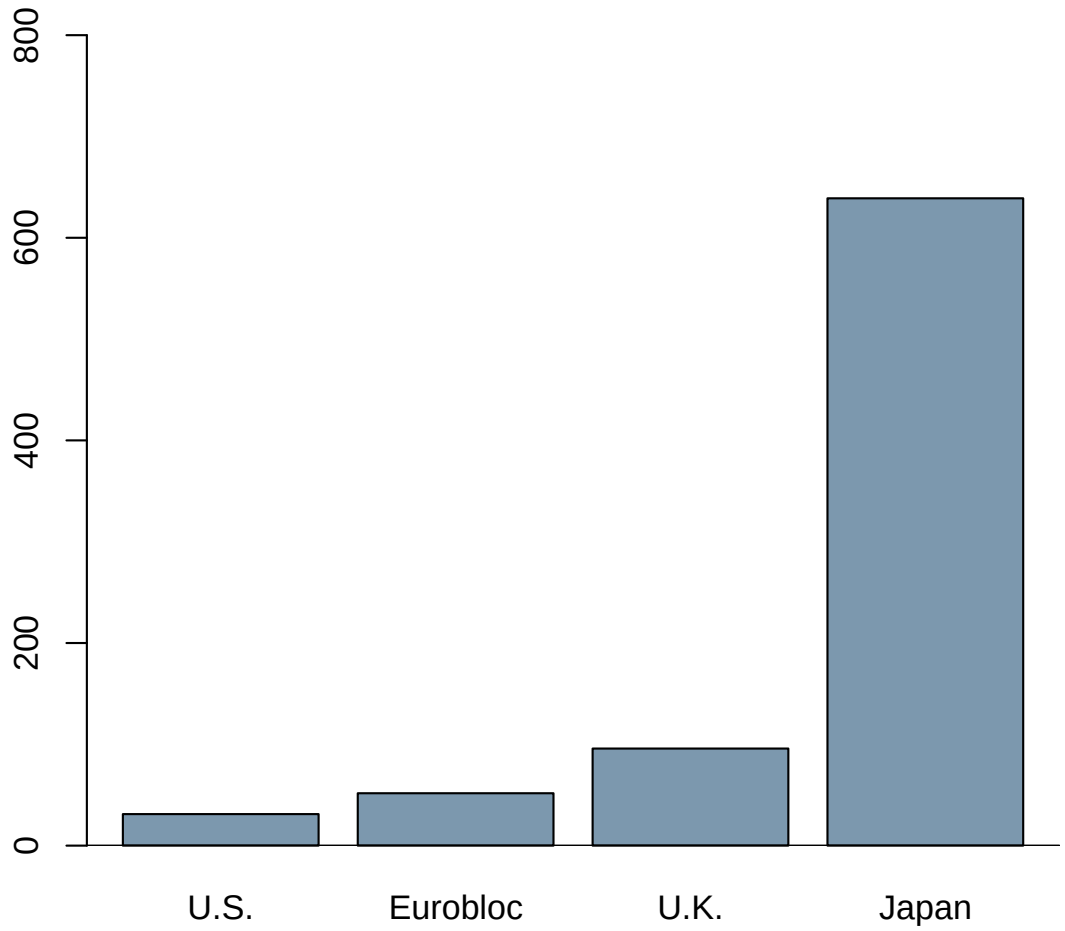
Simulated Portfolio

Number of Traded Bond Futures



Simulated Portfolio

Average Return from Bond Futures



Simulated Portfolio

Portfolio Characteristics

- Sharp ratio: 1.42
- Number of futures traded: 5348.
- Average return per single future: 155 EUR.
- Maximal draw down equities: -66310 EUR.
- Maximal draw down bonds: -8939 EUR.
- Contribution from tactical allocation: 831985 EUR.
- End value of portfolio: 2042979 EUR.