Currency Swap

Markus Schick
University of Bonn

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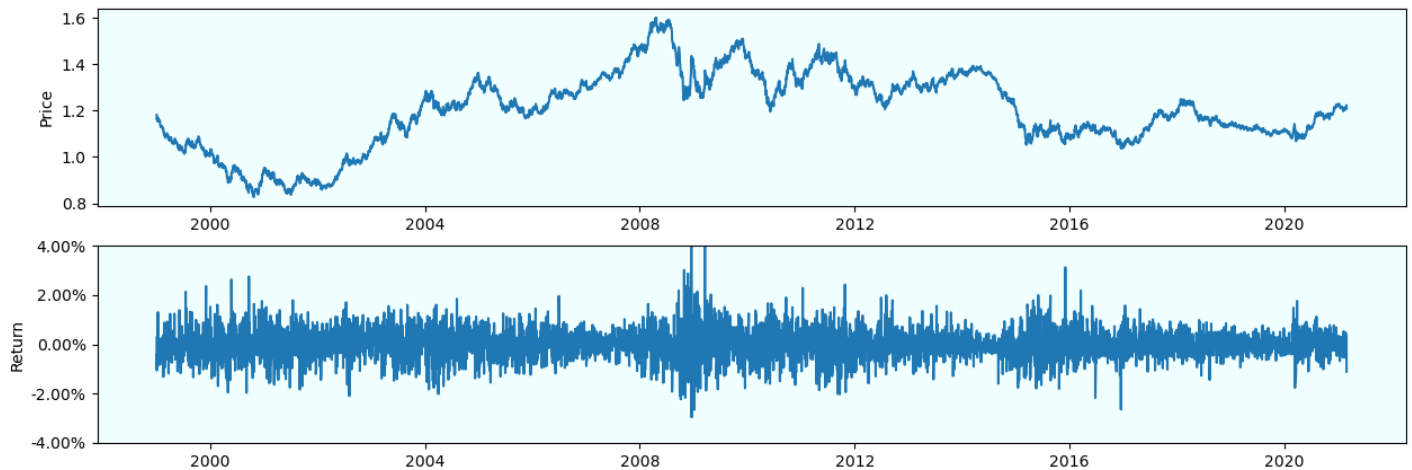
Background

- This is the final project of the course *Effective Programming*
- Work has be done using the template of von Gaudecker (2019)

EURO/USD exchange rate

- EUR/USD exchange rate fluctuated between 0.8 and 1.6
- daily returns are very low with phases of volatility (e.g. in 2008)

Figure: EUR/USD exchange rate volatility



But how large is the change over 1 year?

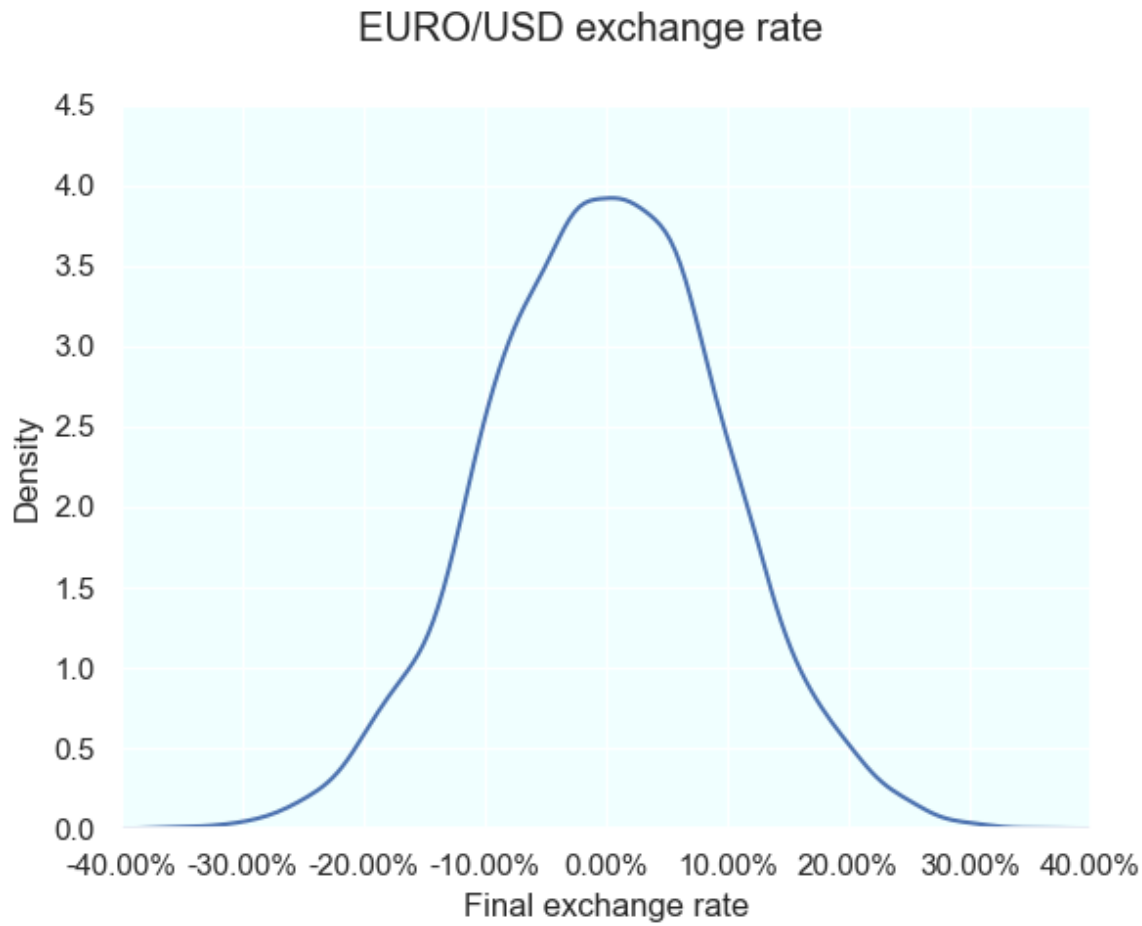
- We take a completely non-parameteric approach
- 1) We look of the sample of 1 year periods from 1990-Today (Historical)
- 2) We (bootstrapp)[] 1 year samples from historical data (Bootstrapping)
- We use the **stationary bootstrap**

Stationary Bootstrap

- keeps the autocorrelated structure of our data intact
- autocorrelation in variance plays a prominent role in financial data (GARCH modelling)
- the recombinator package does the job for us
- optimal (average) interval length is calculated internally

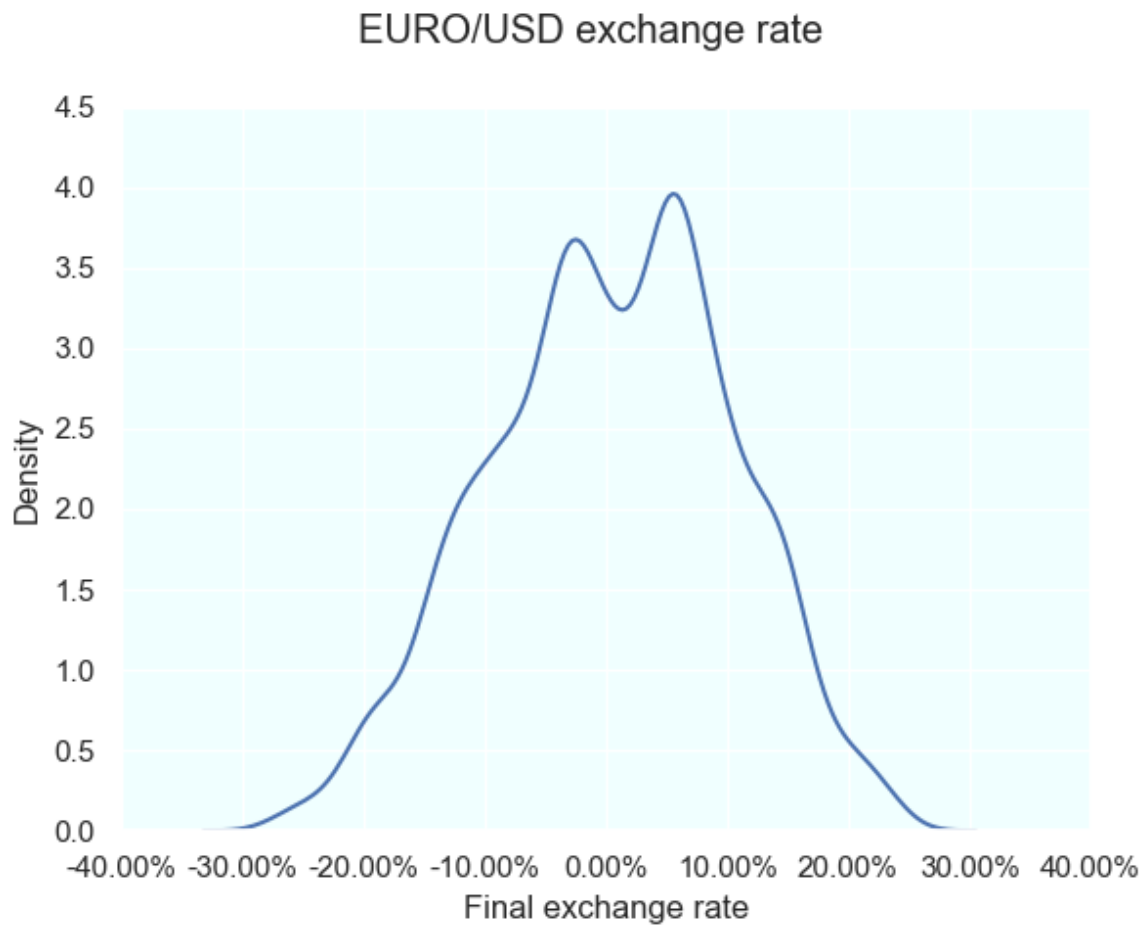
Simulated 1-year EURO/USD exchange rate returns (Bootstrapping)

Figure: Sample created with Bootstrapping



Simulated 1-year EURO/USD exchange rate returns (Historical)

Figure: Sample created with historical exchange rate



What is DEFI?

- offers financial services without relying on (trusted) financial intermediaries
- uses smart-contracts running on a blockchain (majority runs on **Ethereum**)
- completely transparent and efficient, but risky (contracts can be hacked)
- Wikipedia article, Economic paper
- Feel free to reach out if you wanna know more ;)

The Problem

- Algorithmic savings protocols such as **Aave** offer good returns
- require users to hold stable coins (denominated in USD)
- this results in exchange rate risks for users from outside of the US
- worked on fixing this problem on some Ethereum Hackathons
- Now I want to do some simulations of how the current economic design would perform
- and create a framework to quickly iterate on the version

Introduce a swap contract

- Alice goes long Euro by putting 1 Dollar into a smart contract and receiving a token called EURlong
- Bob goes short Euro by putting 1 Dollar into a smart contract and receiving a token called EURshort
- After 1 year the contract allocates the collateral according to below formula

$$EURlong = 1 + \frac{e_1 - e_0}{e_0} * leverage$$

$$EURshort = collateral - EURlong$$

Example calculations

- for $e_0 = 1, e_1 = 1.05, \mathit{leverage} = 2, \mathit{collateral} = 2$
- Alice receives 1.5 USD back
- Bob receives 0.5 USD back
- Why might Alice and Bob take that deal?
- Alice can transform USD assets into EUR assets with EURlong
- Bob can transform USD debt into EUR debt with EURshort

Simulation analysis

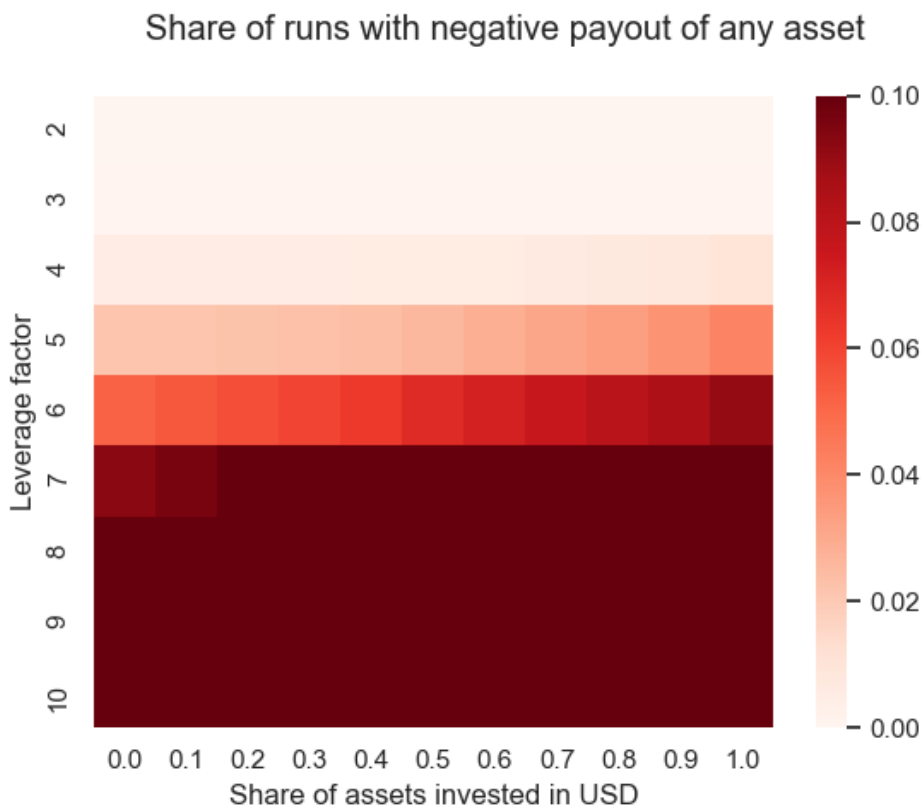
- We know simulate the payoff of the EURlong and EURshort certificate with simulated 1 year returns from before
- In the following I will just show bootstrapped results. Both graphs are produced and are very similar.
- We will show density plots of payouts in all generated scenarios

Number of runs with negative payout

- depending on the exchange rate movement, leverage and asset allocation we might end up with negative income
- this is problematic since we can *typically not enforce demands on a blockchain*
- *We hereby try to minimize the probability of this happening*

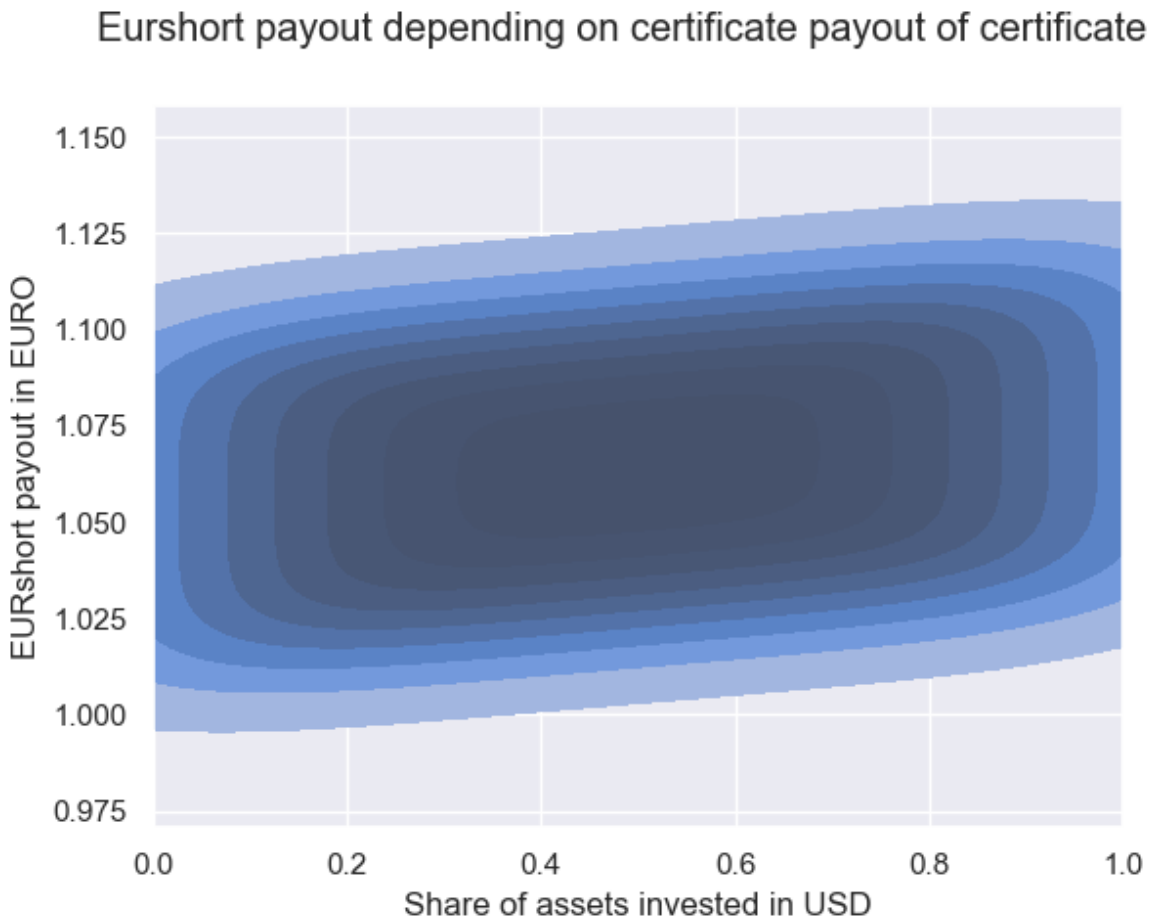
Swap contract payout depending on asset allocation and leverage

Figure: Density of payouts



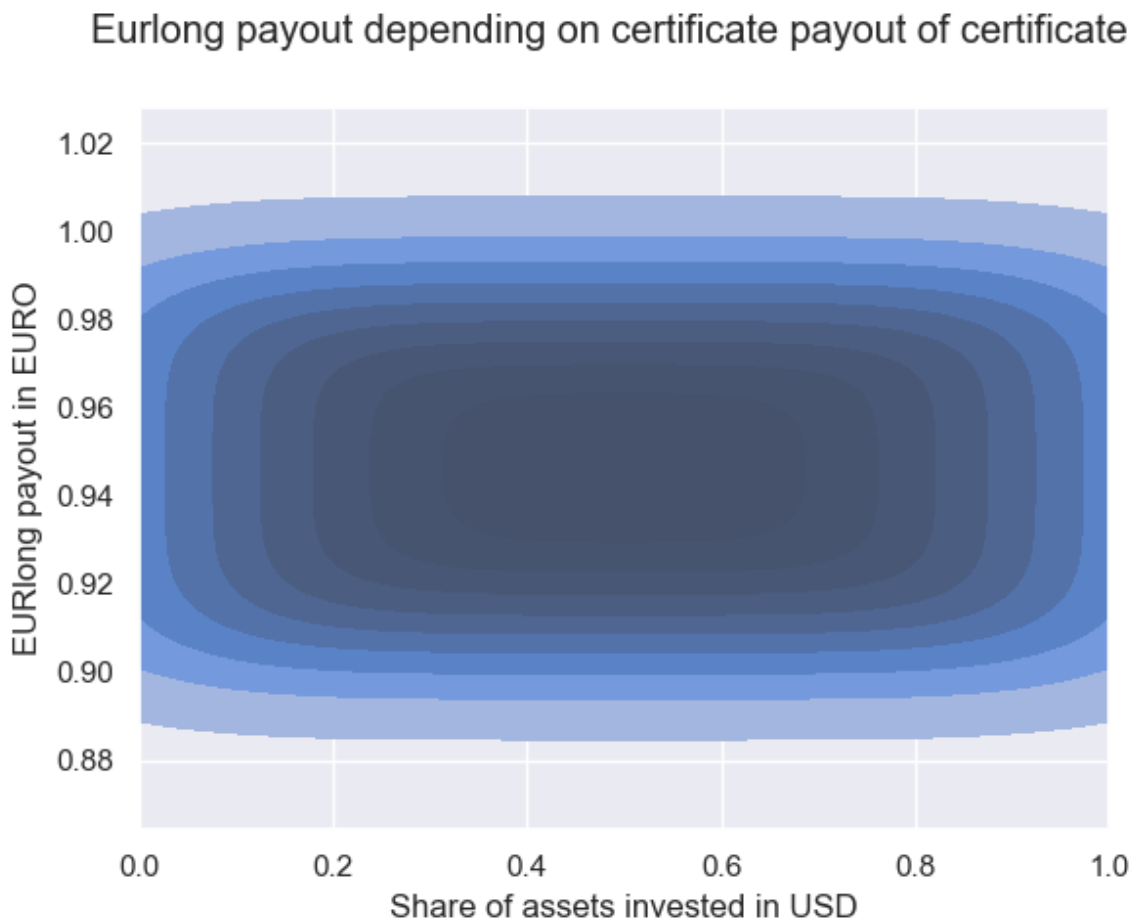
Payout profile of EURO short swap contract

Figure: Sample created with Bootstrapping



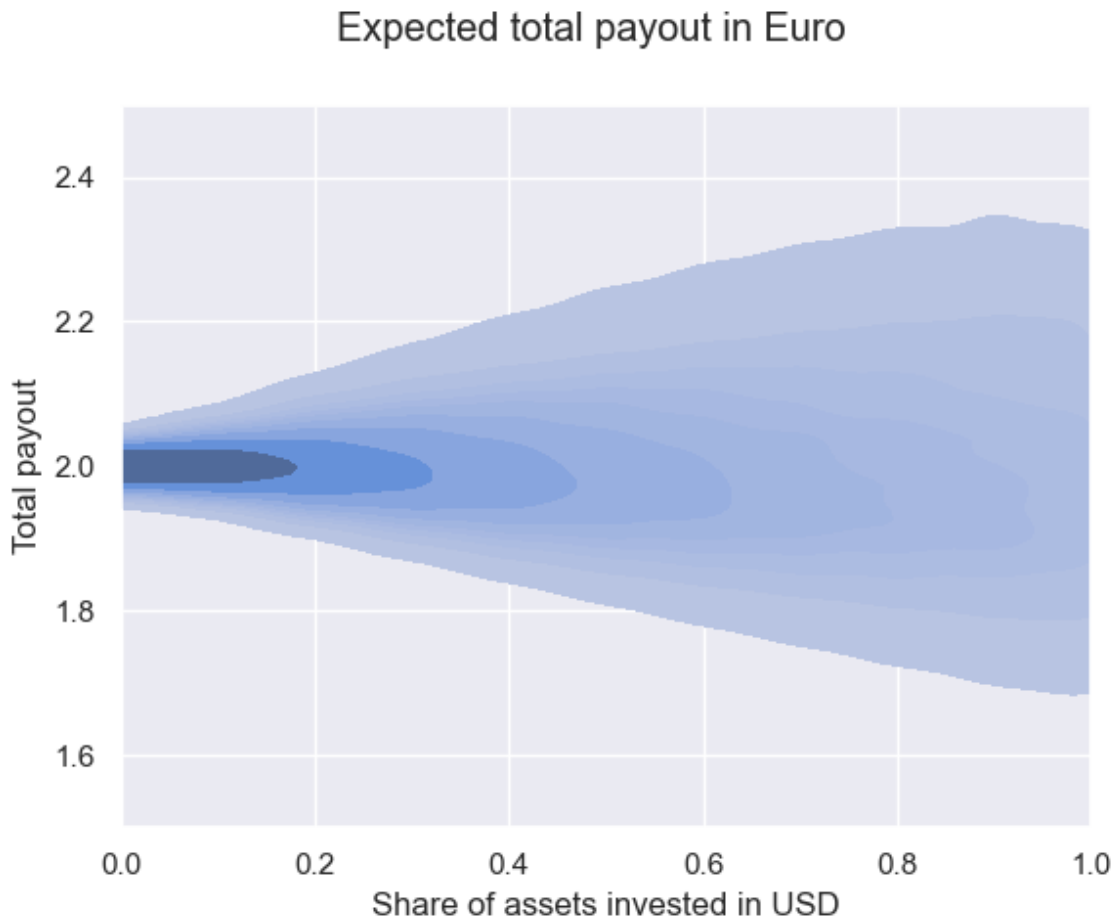
Payout profile of EURO long swap contract

Figure: Sample created with Bootstrapping



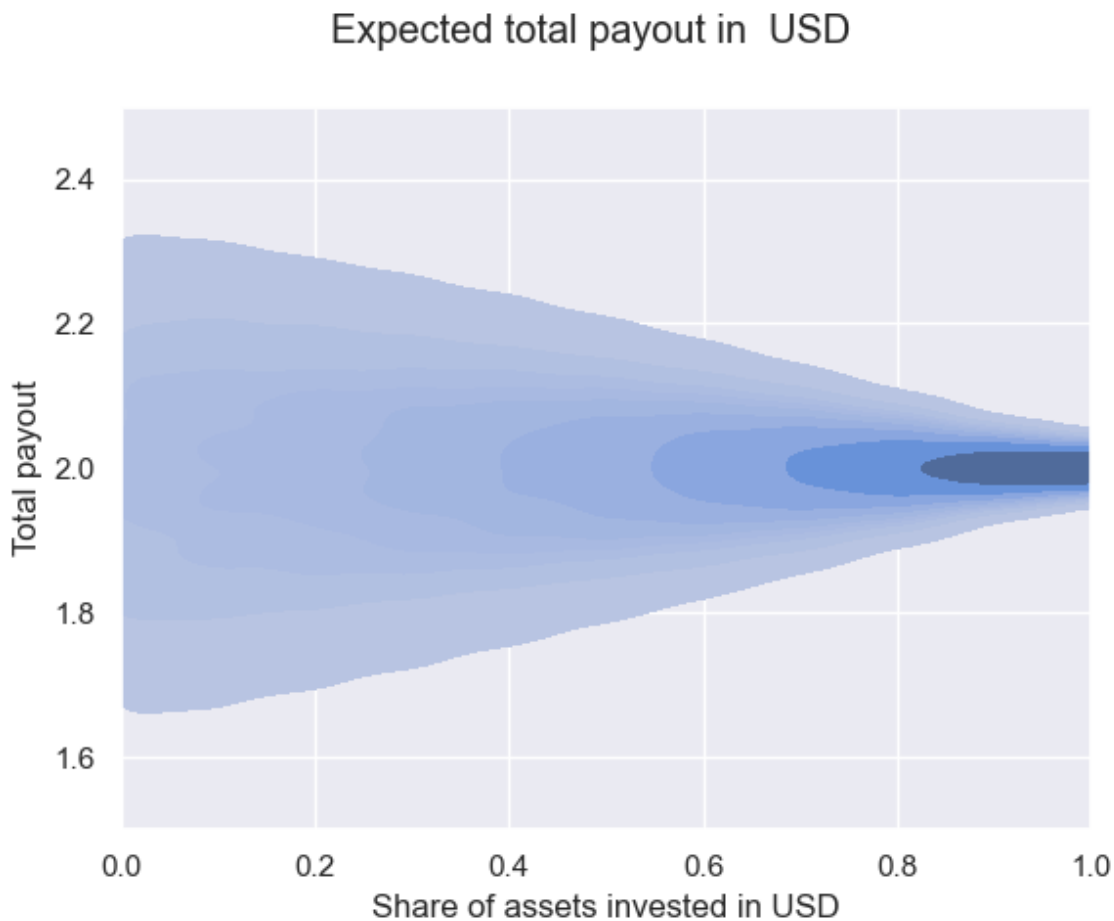
Expected EUR return on collateral locked

Figure: Sample created with Bootstrapping



Expected USD return on collateral locked

Figure: Sample created with Bootstrapping



Conclusion

- leverage factor above 5 must be considered to be unsafe
- higher proportion of assets invested in USD increase payout of EURshort
- higher proportion of assets invested in USD increases chance of negative payout
- more

References I


Gaudecker, Hans-Martin von (2019). "Templates for Reproducible Research Projects in Economics". https://doi.org/10.5281/zenodo.2533241.