

**Strategies**  
for  
**Investing**  
in the  
**S&P 500**



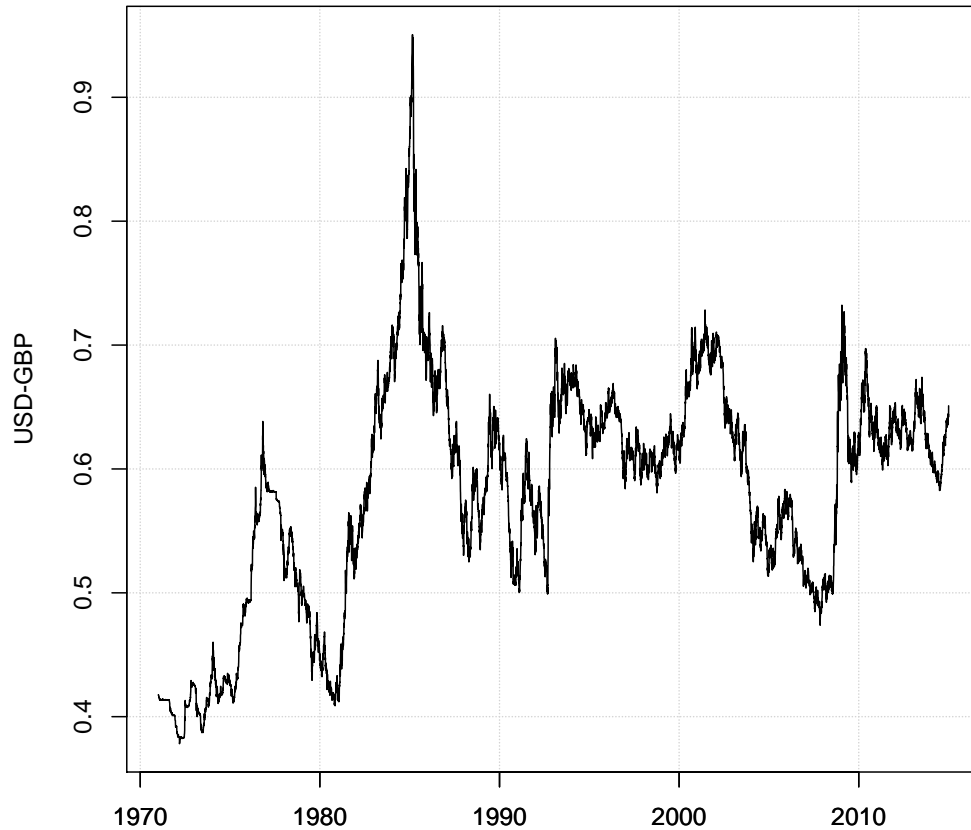
**Magnus Erik Hvass Pedersen**

**Forecasting**  
**Currency Exchange Rates**

By

Magnus Erik Hvass Pedersen

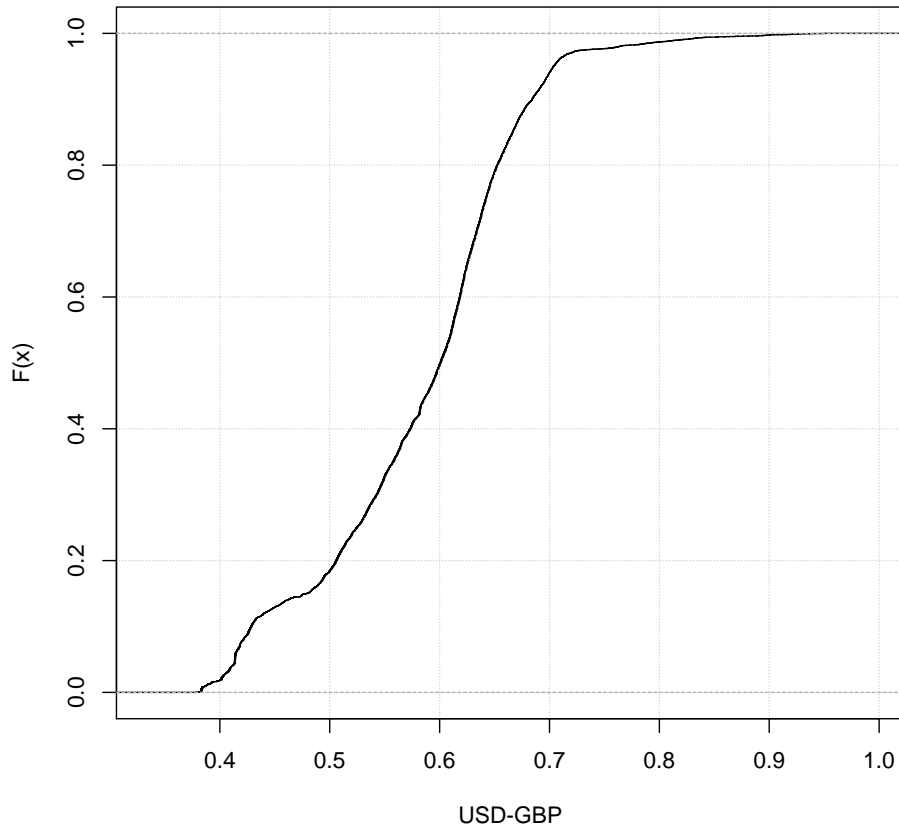
# Exchange Rate for USD-GBP (1971-2015)



Currency exchange rate from US Dollar (USD) to British Pound Sterling (GBP) during 1971-2015.

Exchange rate was 0.6569 in early January 2015. So 1 USD would buy 0.6569 GBP, and 1 GBP would buy  $1 / 0.6569 \approx 1.52$  USD.

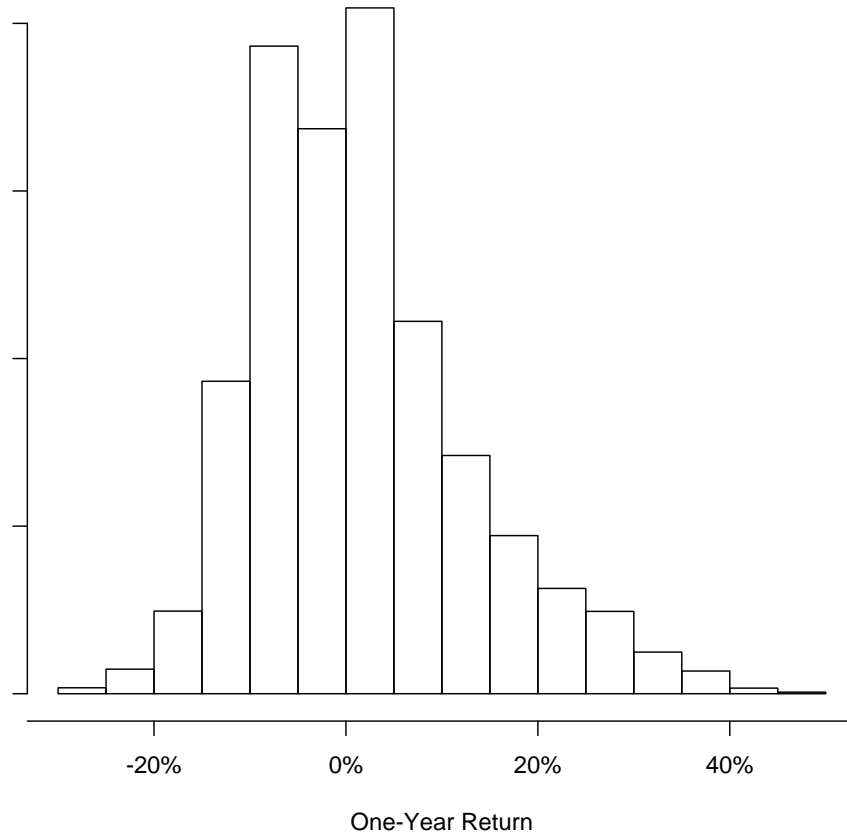
# Cumulative Distribution Function (CDF)



Cumulative Distribution Function (CDF) for USD-GBP exchange rate during 1971-2015.

Exchange rate was 0.6569 in early January 2015. The CDF shows the exchange rate was lower about 82% of the time during 1971-2015.

# One-Year Return on USD-GBP (1971-2015)

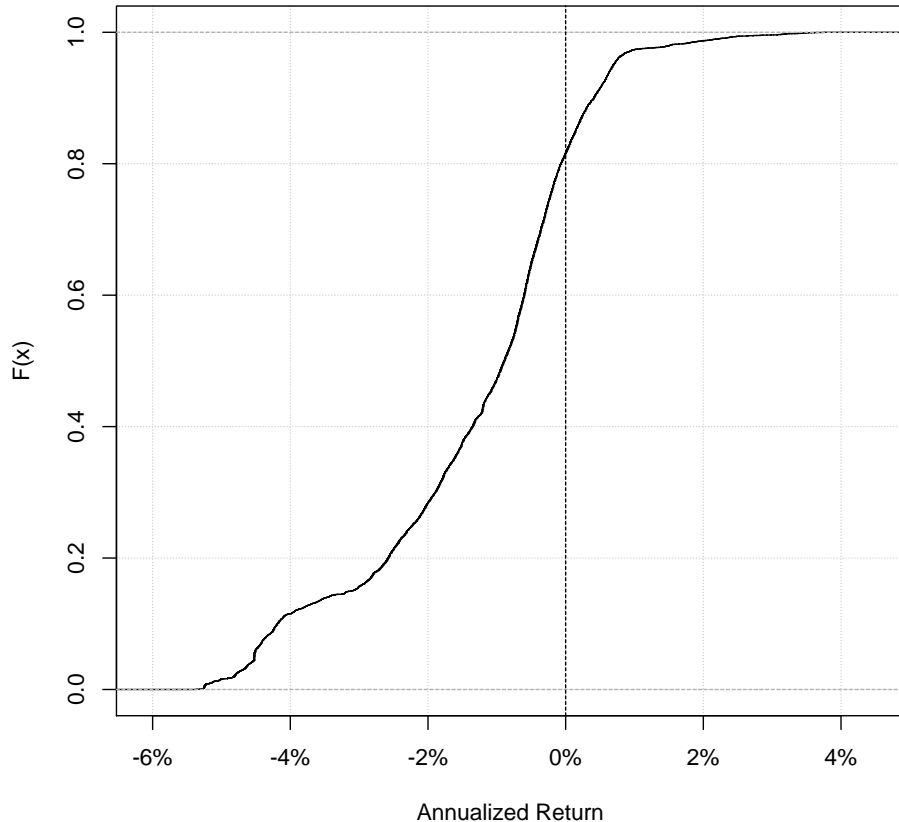


Exchange from GBP to USD and  
after one year back to GBP.

$$\text{One Year Return} = \text{Exch. Rate}_2 / \text{Exch. Rate}_1 - 1$$

Most one-year returns were  
between  $\pm 15\%$ , but some were  
below (20%) and some above 40%.

# 10-Year Annualized Return on USD-GBP



Assume starting exchange rate is:

$$\text{Exchange Rate}_1 = 0.6569$$

Exchange rate after 10 years is from the historical distribution.

$$\text{Annualized Return} = \left( \text{Exch. Rate}_{10} / \text{Exch. Rate}_1 \right)^{1/10} - 1$$

## Example: Annualized Return

Start by exchanging from GBP to USD. Then invest for  $n = 10$  years and assume the investment gains 125%. After 10 years exchange back to GBP and assume a currency loss of (25%). The annualized return is:

$$\begin{aligned} \text{Annualized Return} &= (1 + \text{Investment Return})^{1/n} \times (1 + \text{Currency Return})^{1/n} - 1 \\ &= (1 + 125\%)^{1/10} \times (1 - 25\%)^{1/10} - 1 \approx 5.4\% \end{aligned}$$

The annualized return on the investment was  $(1 + 125\%)^{1/10} - 1 \approx 8.4\%$  and the annualized return on the currency was  $(1 - 25\%)^{1/10} - 1 \approx (2.8\%)$

# Estimating Annualized Return by Addition

The correct way of calculating the annualized return is by multiplying the annualized returns for the investment and the currency.

If the investment's annualized return is 8.4% and the currency's annualized return is (2.8%), then the combined annualized return is:

$$\textit{Annualized Return} = (1 + 8.4\%) \times (1 - 2.8\%) - 1 \approx 5.4\%$$

... but adding the returns gives a reasonable estimate when the returns are moderate and we don't know the true distribution anyway:

$$\textit{Estimated Annualized Return} = 8.4\% - 2.8\% = 5.6\%$$

# **Example: Estimating Annualized Return**

The Cumulative Distribution Function (CDF) on a previous slide estimated the annualized return on the currency between (5%) and 3% over a 10-year period and a starting exchange rate of 0.6569.

If the investment's annualized return is estimated at e.g. 8% then adjusting for the currency return gives a range of 3-11%.

If the investment's annualized return is estimated at e.g. (3%) then adjusting for the currency return gives a range of (8%) to 0%.



# Conclusion

- If two countries develop similarly to their past, then we can use the historical currency exchange rate to forecast the future rate.
- This can be used to estimate a range for the currency-adjusted returns on investments made in foreign currencies.

The book gives more details and also considers other currencies.

## **Strategies for Investing in the S&P 500**



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