Tilburg University

Introduction Asset Pricing

Assignment 2

Report

- The deliverable of this assignment is a report (including your names and student numbers, with a maximum of three students per group) with answers to the below and also the code(s) that you use to generate the output.
- The assignment is due May 25, 17:00.

Exercise 1

- Choose a day between April 25 and May 25, 2023. Present the (Nelson-Siegel-Svensson) yield curve and discount curve using the parameters reported by the ECB during this day and compare your curves with those of April 11, 2023. (Website: see computer lab.)

- Calculate and present the value of a coupon bond at this day with maturity 20 years, face value 1000, coupon payments 1%, with coupon payments each half year.

Exercise 2

Go to the data library of Kenneth French. (Website: see computer lab.) Download the returns of a *sufficient* number of portfolios at your frequency of preference (you have to test using Hansen's J-test!). Also download the five Fama-French factors and the return on the market portfolio. Take care of the differences between %, fractions, net, and gross returns! Make sure that you include the most recent observations.

1. Describe the return series that you use: Source, frequency, sample period,…Also present commented *sample/descriptive statistics* of the return series that you use.

Exercise 3

1. Estimate the (non-normalized) SDF of the Fama-French five factor model, using your downloaded portfolio returns, together with the market return and the return on the risk free asset. Choose first some appropriate $\widehat{\mathbf{W}}$-matrix, such that (see slides)

$$\begin{pmatrix} \hat{A} \\ \widehat{\mathbf{B}} \end{pmatrix} = \left(\left(\frac{1}{T} \sum_{t=1}^{T} \begin{pmatrix} 1 \\ \mathbf{f}_t \end{pmatrix} (\mathbf{R}_t)' \right) \widehat{\mathbf{W}} \left(\frac{1}{T} \sum_{t=1}^{T} \mathbf{R}_t \begin{pmatrix} 1 & \mathbf{f}_t{}' \end{pmatrix} \right) \right)^{-1} \left(\left(\frac{1}{T} \sum_{t=1}^{T} \begin{pmatrix} 1 \\ \mathbf{f}_t \end{pmatrix} (\mathbf{R}_t)' \right) \widehat{\mathbf{W}} \boldsymbol{\iota} \right)$$

Present the estimates in combination with the corresponding asymptotic standard errors. Briefly discuss your findings.

Exercise 3

2. Next, choose for $\mathbf{W}$ the optimal matrix. Estimate this optimal $\mathbf{W}$-matrix using the estimates of the previous exercise. Using the optimal estimated $\mathbf{W}$-matrix, do the second round estimation. What are now the asymptotic standard errors of the resulting estimates? Compare with the first round estimates! Briefly discuss your findings.

<u>Remark</u>: If you like you may also replace the second round by an *iterative* procedure, since this might yield better *numerical* results (although the *asymptotic characteristics* remain the same).

Exercise 3

3. Finally, test the validity of the Fama-French five factor model by applying Hansen's J_T-test, i.e., test the hypotheses

$$H_0\colon E(M_t\mathbf{R}_t) = \boldsymbol{\iota} \text{ vs. } H_1\colon E(M_t\mathbf{R}_t) \neq \boldsymbol{\iota}$$

using as test statistic (see also slides lecture)

$$J_T = T\left(\frac{1}{T}\sum_{t=1}^{T}\left(\boldsymbol{\iota} - \mathbf{R}_t\left(\hat{A} + \widehat{\mathbf{B}}'\mathbf{f}_t\right)\right)\right)' \,\hat{\mathbf{S}}^{-1}\left(\frac{1}{T}\sum_{t=1}^{T}\left(\boldsymbol{\iota} - \mathbf{R}_t\left(\hat{A} + \widehat{\mathbf{B}}'\mathbf{f}_t\right)\right)\right)$$

Present your findings. What are your conclusions?

Exercise 4

1. Estimate the Hansen-Jagannathan Bound $f\big(E(M_t)\big)$, reproduced below for the sake of completeness, using your portfolio returns.

- $\sigma(M_t) \geq f\big(E(M_t)\big) \equiv \sqrt{(E(\mathbf{R}_t)E(M_t) - \boldsymbol{\iota})'\mathrm{cov}^{-1}(\mathbf{R}_t)(E(\mathbf{R}_t)E(M_t) - \boldsymbol{\iota})}$.

   Present a plot of $f(x)$ as a function of different values of $x = E(M_t)$.

2. What can you say about the SDF $M_t = \beta(R_t^m)^{-\gamma}$ for different values of β and γ? Motivate your chosen range!