Question 1: The Basics

The main goal of financial markets is to channel capital to its most productive use. In the current market environment, we see that there is a lot of capital available (ageing population, quantitative easing) and interest rates are low, pushing investors towards the equity market (TINA, there is no alternative).

a. (6 points) Explain what the current market situation might do to the efficiency of capital allocation.

ANSWER:
Option 1: Markets are efficient, such that prices reflect all information. In such a case, allocation is efficient regardless the situation.
Option 2: The excess capital pushes up prices too high, such that there is mis-allocation of capital.

In the Capital Asset Pricing Model (CAPM), the beta measures the sensitivity of a stock to the market index.

b. (6 points) Explain what you think happened to the market beta of Zoom Video Communications Inc. during the outbreak of the Corona crisis (March, April). How did this affect its expected return according to the CAPM?

ANSWER:
The overall market went down, whereas zoom went up. As such, the beta went DOWN (4 points). A lower beta implies LOWER expected return (2 points).

Imagine you would want to test whether a stock's sensitivity to Corona is priced in the cross-section of stocks returns.

c. (8 points) Explain step-by-step how you would test this using the Fama-MacBeth methodology.

ANSWER:
- Step 1: find a measure of Corona (e.g., daily number of infections per country)
- Step 2: estimate a Corona beta as well as market for each stock over the first 4 years
- Step 3: sort stocks based on their corona beta and make portfolios
- Step 4: re-estimate Corona beta and market beta over the next 5 years
- Step 5: run cross-sectional regressions in year 10, with return in month t+1 as dependent variable and Corona beta, market beta, and other controls (size, btm, mom) as independent varaiables.
- Step 6: calculate average and st.dev. of coefficients, and determine significance

Question 2: Factor Models

I downloaded the returns for Apple and Zoom but accidentally deleted the labels; I don't know which returns belong to which company. Now I estimate the Fama-French 3-factor model on both return series to figure out which is which.

$$r_t = \alpha + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t$$

These are the estimation results (t-statistics in parentheses) for the two companies:

	Company 1	**Company 2**
α	0.158	0.387
	(2.356)	(1.882)
β_1	1.206	0.280
	(27.30)	(1.560)
β_2	-0.379	1.150
	(-3.222)	(3.503)
β_3	-0.292	-1.848
	(-4.609)	(-6.786)
R^2	0.755	0.186

a. (8 points) Explain which of the two companies represents Apple and which represents Zoom.

ANSWER:

1. Beta1 of company 1 is larger than Beta1 of company 2. (Beta1 is the market beta). This is an indication that Company 1 is Apple and Company 2 is Zoom because Apple is more 'cyclical' (it's a tech company but in the end sells high-end phones/tablets/laptops) so more sensitive to business cycles than Zoom. Also because Zoom exploded in the Covid crisis while the market dropped.

2. Beta 2 of company 1 negative, whereas Beta 2 of company 2 is positive. This is the strongest indication that Company 1 is Apple and Company 2 is zoom. Apple is well known as the the most valuable company in the world, so it should load negatively on SMB. Zoom is a very young company and still relatively small, so loads positively on SMB.

3. Beta 3 of company 1 is less negative than Beta 3 of company 2. So both are growth stocks (low book to market). However, Zoom has more of a growth character than Apple because Apple is not only an IT (software) company but has much fixed assets.

4. The R-squared of Company 1 is higher than Company 2. Related to Beta 1, this shows that Company 2 has more 'idiosyncratic' of company specific risk than Company 1. This fits Zoom better than Apple.

Fama and French (2015) introduce the 5-factor model. In the paper, they try to explain the economic intuition behind their findings using the following model:

$$m_t = \sum_{\tau=1}^{\infty} E(d_{t+\tau}) / (1+r)^{\tau}$$

$$M_t = \sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau}) / (1+r)^{\tau}$$

$$\frac{M_t}{B_t} = \frac{\sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau}) / (1+r)^{\tau}}{B_t}$$

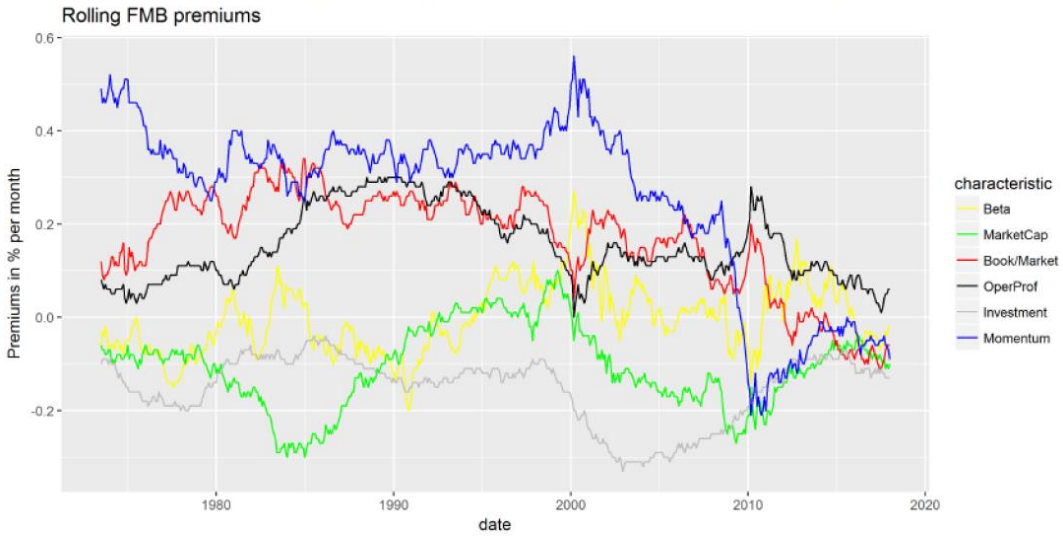
in which *m* is the stock price, *d* is dividend, *r* the discount rate, *M* the market capitalization, *Y* total earnings, and *B* book value.

b. (5 points) Explain, based on the above model, why companies that invest more have lower expected returns.

ANSWER:
Keeping everything constant apart from dB (=investments) and r, a higher dB means a lower r. So higher investments lead to lower returns, because less earnings (Y) can be paid as dividends.

The figure below shows the 10-year rolling Fama-MacBeth premia, i.e., the γ's from the regression
$r_i = \alpha + \gamma_1\beta + \gamma_2 Size_i + \gamma_3 BTM_i + \gamma_4 Mom_i + \gamma_5 Profit_i + \gamma_6 Investments_i + \varepsilon_i$

Figure 1: 10-year rolling Fama-MacBeth estimates of factor premia



c. (7 points) Explain which period in the figure was the best from the perspective of the regulator.

ANSWER:
Option 1: if the factors represent MISPRICING, then the regulator prefers the latest years because the premia are disappearing -> no more mispricing.

Option 2: if the factors represent RISK, then there is no preference, anything is fine because the factors represent risk and therefore should be priced.

Question 3: Behavioral Finance

Limits to arbitrage are a central concept in Behavioral Finance; they come in three forms: implementation costs, noise trader risk, and fundamental risk. Now assume that you believe that the stocks of the company Tesla are over-valued in today's market.

a. (6 points) Explain which of the three limits to arbitrage might prevent you from profiting from this over-valuation.

ANSWER:
- Implementation costs: Yes, because you'll need a short position. These are relatively expensive due to margin.
- Fundamental risk: Yes, because it is not a long-short strategy; the fundamental price of Tesla could move against the arbitrageur (i.e., go up). Furthermore, Tesla has HIGH idiosyncratic risk due to the nature of the company.
- Noise trader risk: Yes, because many retail investors bought the stock, thereby pushing up the price too high. This could continue in the short run.

One of the limits to arbitrage, 'noise trader risk', is further developed in the study by DeLong, Shleifer, Summer, and Waldman (1990). In their model, the return difference between sophisticated traders and noise trader is given by

$$E(\Delta R_{n-i}) = \rho^* - \frac{(1+r)^2(\rho^*)^2 + (1+r)^2\sigma_\rho^2}{(2\gamma)\mu\sigma_\rho^2}.$$

in which ρ^* is the average misperception of noise traders, r the risk-free rate, σ the variation in the misperception, μ the proportion of noise traders, and γ the risk aversion.

b. (7 points) Intuitively explain why the return of noise traders relative to sophisticated traders goes up if there are more noise traders in the market (a higher μ).

ANSWER: More noise traders (higher \mu) makes the create space effect stronger. More noise traders means more volatility in the market; this drives out the risk averse arbitrageurs.

Baker and Wurgler (2007) develop a sentiment index, and test whether it is priced in the cross-section of stock returns. To do so, they estimate the following equation:

$$R_{X_{it}=High,t} - R_{X_{it}=Low,t} = c + dSENTIMENT_{t-1} + \beta RMRF_t + sSMB_t + hHML_t + mUMD_t + u_t.$$

c. (7 points) Explain why they take sentiment in period (t-1) and all other factors in period (t).

ANSWER: Because sentiment predicts mean-reversion in period t. All other factors (only) have contemporaneous effects.

Question 4: Beyond mean-variance utility

Barberis et al. (2016) test to what extent Prospect Theory is important in describing the cross-section of stock returns. These are (part of) their results:

TK	**−0.107**	**−0.108**	**−0.059**	**−0.050**	**−0.043**	**−0.043**
	(−3.77)	(−4.94)	(−3.07)	(−2.60)	(−2.16)	(−2.18)
Beta		0.132	0.166	0.192	**0.240**	**0.243**
		(1.14)	(1.22)	(1.40)	(1.99)	(2.07)
Size		**−0.132**	**−0.125**	**−0.078**	**−0.097**	**−0.089**
		(−4.07)	(−3.65)	(−2.44)	(−3.38)	(−3.24)
Bm		**0.151**	**0.203**	**0.177**	**0.126**	**0.127**
		(2.67)	(3.44)	(3.06)	(2.26)	(2.29)
Mom		**0.01**	**0.009**	**0.009**	**0.008**	**0.009**
		(7.99)	(6.47)	(6.73)	(6.39)	(6.47)
Rev			**−0.079**	**−0.079**	**−0.078**	**−0.081**
			(−16.39)	(−16.28)	(−15.20)	(−16.47)
Illiq				**0.286**	**0.597**	**0.622**
				(2.37)	(4.90)	(5.08)
Lt rev					−0.041	−0.039
					(−1.40)	(−1.31)
Ivol					**−0.138**	0.068
					(−4.27)	(1.43)
Max						**−0.036**
						(−3.45)
Min						**−0.059**
						(−4.50)
Skew						

a. (6 points) Explain to what extent prospect theory helps, in this table, to solve the problem that the CAPM beta is not priced in the cross-section of stock returns.

ANSWER:
Starting from model 5, the market beta becomes significant. This implies that after correcting for enough factors, including TK, market beta becomes priced again.

It turns out that stock with a high maximum daily return in the previous month, have a lower expected return in current month.

b. (6 points) Explain how prospect theory can help explain this finding.

ANSWER:
Part of prospect theory is probability transformation, implying that people over-estimate small probabilities. Hence, for lottery-like stocks, like stocks with a high recent return MAX, the small probability of a large positive return is exaggerated. This causes overpricing.

Question 5: Frictions

One of the consequences of the electronification and subsequent fragmentation of exchanges, is the rise of private exchanges, or dark pools.

a. (6 points) Explain why market regulators are in general not happy with the activities of dark pools.

ANSWER:
- Transparency; regulators want transparent markets such that all market participants have access to the same information. This creates a level playing field.
- Liquidity fragmentation is bad for market stability
- informed investors are separated from uninformed. Again, no level playing field.

Liquidity knows three dimensions: Time, Costs, and Price-impact. At the same time, we know that there are two (main) types of exchanges: Order driven and quote driven.

b. (8 points) Explain to what extent the three dimensions of liquidity are relevant to both types of exchanges.

ANSWER:
- Time: More relevant for order driven, because of the limit orders. Not so relevant for quote driven because there is guaranteed liquidity by the market maker; one can ALWAYS trade.
- Price impact: More relevant for order driven, because price impact depends on the depth of the order book. The market maker in a quote driven market will also widen the spread for large orders, but not as much.
- Cost: More relevant for quote driven, because the spread is typically wider because of the costs and risks of the market maker.

One of the main findings of the study by Brunnermeier and Pedersen (2009) is that there is a strong commonality in market liquidity across stocks (in other words, a high correlation between changes in market liquidity for stocks).

c. (7 points) Explain, using the concept of funding liquidity, why this is the case.

ANSWER:
Funding liquidity is a MARKET WIDE factor. So it affects all stocks. Hence, of funding liquidity is tight, the market liquidity of ALL stocks will be affected. This creates correlation between market liquidity of stocks.

The executive director of the Austrian market regulator FMA, Helmut Ettl, stated in the Financial Times on May 18, 2020:

"The restrictions on short selling have made an important contribution to absorb the irrational overreactions of the markets as well as to maintain investor confidence in the stability of the Austrian financial market,"

d. (7 points) Give your educated opinion about this statement, based on the results of Beber and Pagano (2013).

ANSWER:
Beber and Pagano show that short sale are bad for market quality. Hence, the "investor confidence" is likely not to be restored because of the ban. Furthermore, Beber and Pagano find limited evidence for price support due to the short sale ban. Hence, the overreaction (=too low prices in this case) is most likely not eliminated.
Overall: the statement is NOT in line with the findings of Beber and Pagano.