

FINM3405 Derivatives and risk management

Tutorial Sheet 1: Introduction to derivative securities

Suggested solutions

August 4, 2024

Question 1. 1. What is a derivative security?

A derivative security is an agreement between two or more parties to undertake financial transactions in the future dependent on or derived from other future events. This is a slightly more abstract definition than what one usually encounters in order to encompass the whole range of derivative securities traded and/or originated and negotiated in financial markets (think of weather derivatives and credit default swaps). A typical definition is a derivative security is a financial security whose payoff and value is derived from other financial securities.

2. What is the role of derivative security markets in the economy?

The main reason derivative security markets evolved is to enable businesses and other parties such as governments and wealthy individuals to manage and reduce financial and other risks that arise in their usual core business activities, enabling these parties to go about their usual activities more confidently. From another perspective, one might say that the role of derivative security markets is the reallocation of risks from parties who are not specialists in managing them (particularly when it's not their core business activity), to other parties who are willing to take them onboard and are specialists in managing them (typically if it's their core business activity). In general, derivative security markets facilitate risk management in the economy. This enables businesses, governments and individuals to innovate, take risks and expand the activities and business ventures they take on, and products and services they're able to offer, increasing economic and technological development and consequently living standards, human welfare and prosperity.

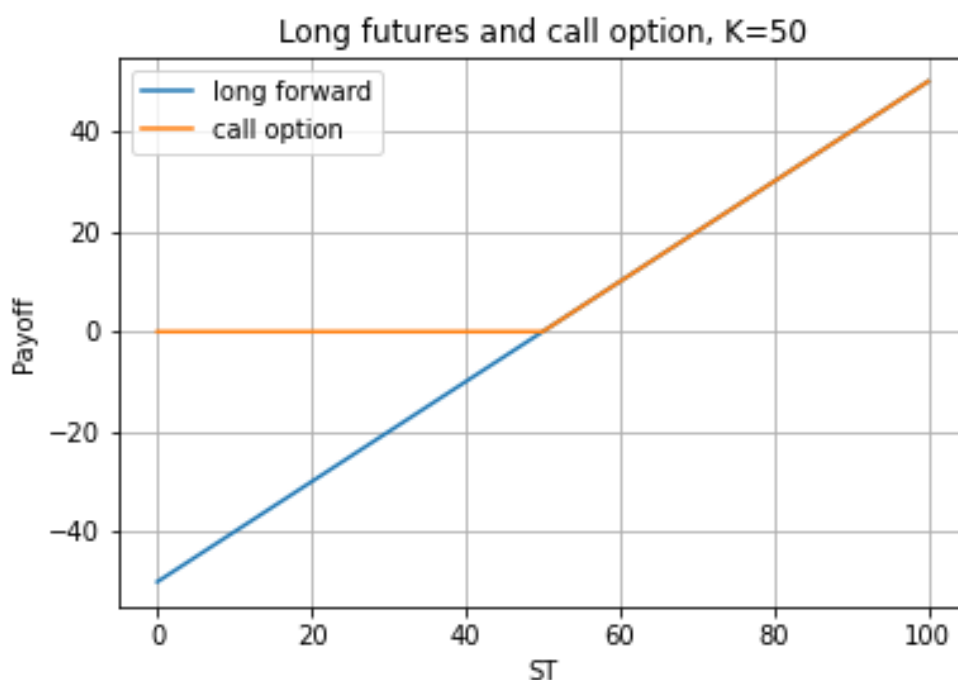
3. What is the main difference between forwards/futures and options?

Options effectively give one party, the *holder* or *taker*, the choice of whether to enforce the agreement or not. A call option gives the holder the right

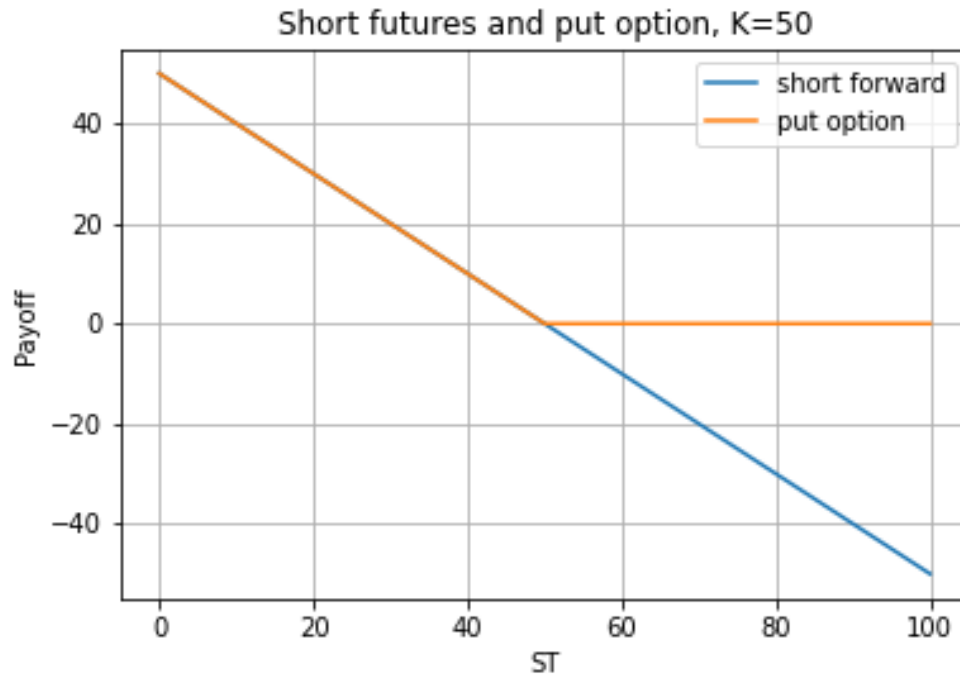
but not the obligation to buy the underlying asset for the agreed price on (European) or anytime up to (American) the agreed expiry date; for put options, the right is to sell the asset or not. Forwards and futures obligates the parties to undertake the transaction on the contract's maturity or delivery date, regardless of the price of the underlying asset on that future date. This basic difference has profound implications.

4. How do you use futures and options to speculate on an expected increase in the price of the underlying asset over the short term? What about a decrease? Plot the payoff diagrams from your strategies.

The most basic way to speculate on an increase is to go long futures/forwards (payoff: $S_T - K$), or to buy/take call options (payoff: $\max\{0, S_T - K\}$). For a decrease, you'd short futures/forwards (payoff: $K - S_T$), or buy/take a put option (payoff: $\max\{0, K - S_T\}$). Some payoff diagrams plotted using Python's popular Matplotlib library using a futures/forward contract and option strike price of $K = \$50$ are:



The call option's payoff reflects the “right but not the obligation” aspect of options. Since a call option gives the hold the right but not the obligation to buy the underlying asset for the strike price K at expiry/maturity, when the asset's spot price S_T in the market at maturity, time T , is less than the strike price, the call option holder does not buy the asset via the option (does not exercise the option), but instead buys the asset spot for the cheaper price in the market.

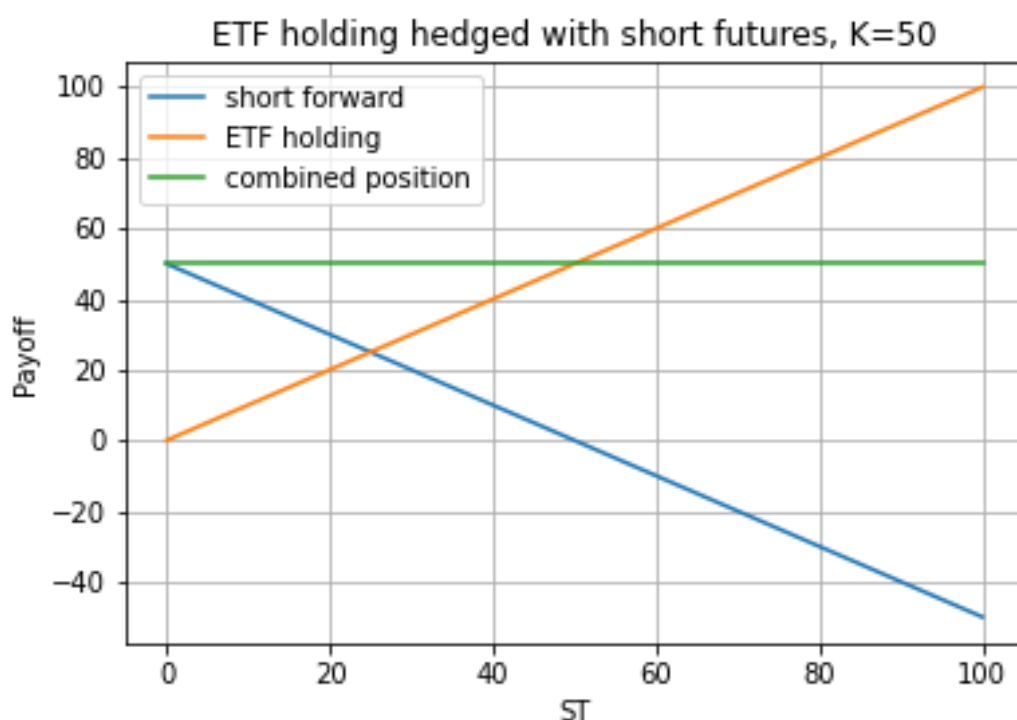


Note that these plots are *payoffs* and hence don't include the option premium. The Python code that produced these plots is below.

5. Suppose you hold a S&P/ASX200 index ETF and you're worried about the market falling over the short term, but you don't want to sell your holding.

- (a) How would you use futures contracts to manage this risk? Plot a payoff diagram of your strategy. What futures contracts are available for this?

To manage the risk of a market fall you short futures contracts. For simplicity, let's assume that 1 futures contract is over 1 unit of the ETF, and your hedging date is exactly the maturity date of the contract. Also let $K = 50$. Your position or payoff at maturity is the ETF holding plus the short futures contract: $S_T + (K - S_T) = K$:



One could possibly use the ASX SPI 200 Index or ASX MINI SPI 200 Index Futures, or even LEPOs over the individual ETF if one exists.

Contract specifications

	ASX SPI 200	ASX MINI SPI 200
Trading platform	ASX 24	ASX 24
Underlying index	S&P/ASX 200 Index	S&P/ASX 200 Index
Contract unit	Valued at A\$25 per index point (for example, A\$197,500 at 7,900 index points)	Valued at A\$5 per index point (for example, \$39,500 at 7,900 index points)
Contract months	<ul style="list-style-type: none"> March/June/September/December Up to six quarter months ahead and nearest two non-quarterly expiry months	<ul style="list-style-type: none"> March/June/September/December Up to two quarter months ahead and nearest two non-quarterly expiry months
Commodity code	AP	AM
Listing date	02/05/2000	12/10/2015
Minimum price movement	One index point (A\$25)	One index point (A\$5)
Last trading day*	All trading in expiring contracts ceases at 12.00pm on the third Thursday of the settlement month. Non-expiring contracts underlying futures contract will continue to trade as per the trading hours.	
Cash settlement price*	The Special Opening Quotation of the underlying S&P/ASX 200 Index on the last trading day, calculated using the first traded price of each component stock in the S&P/ASX 200 Index on the last trading day, irrespective of when those stocks first trade in the ASX trading day. This means the first traded price of each component stock may occur any time between ASX market open and ASX market close (including the Closing Single Price Auction) on the last trading day. If a component stock hasn't been traded by ASX market close on the last trading day, the last traded price of that stock will be used to calculate the Special Opening Quotation.	
Trading hours*	Day and night trading sessions that are accessible almost 24 hours a day: <ul style="list-style-type: none"> 5.10pm to 7.00am and 9.50am to 4.30pm (Sydney time, during US daylight saving time) 5.10pm to 8.00am and 9.50am to 4.30pm (Sydney time, during US non-daylight saving time) 	
Settlement day*	The first business day after expiry, ASX Clear (Futures) publishes the final settlement price of the contract. On the second business day after expiry, ASX Clear (Futures) settles cash flows as a result of the settlement price.	
Headline fee	\$1	\$0.25
Block trade size	200	1000
Exchange for physical	Yes	Yes
CFTC approved	Yes	Yes

*Sydney times

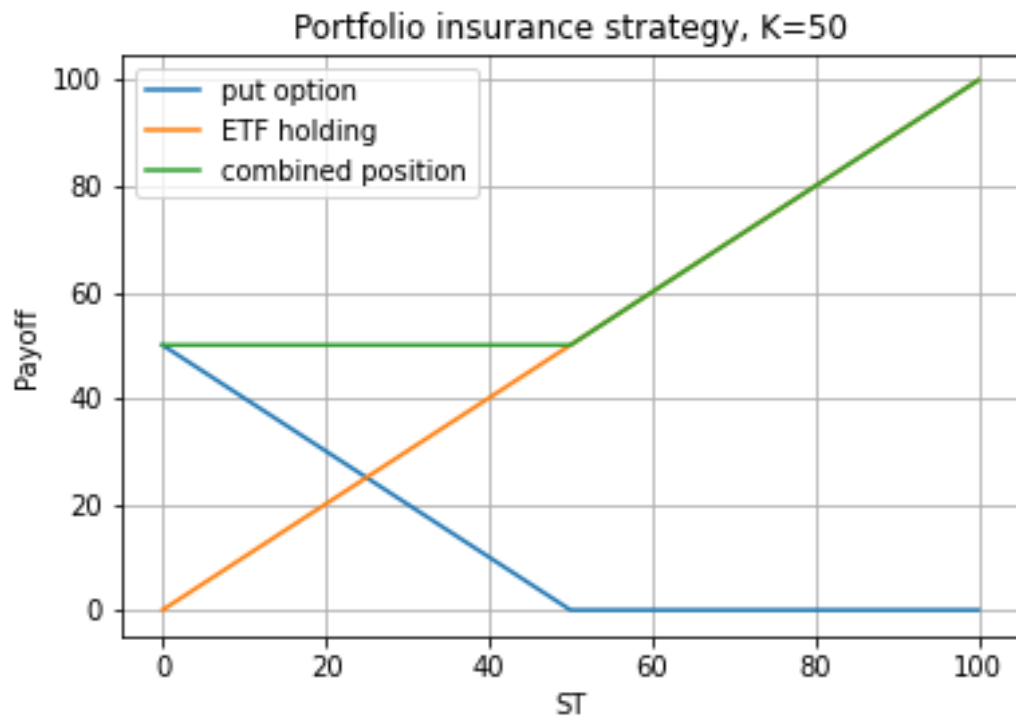
LEPOs key features

Name	LEPO – Low Exercise Price Option.
Description	A LEPO is like a forward purchase of shares for the buyer and a forward sale of shares for the seller. Note that the buyer of a LEPO does not obtain voting rights or dividends until the shares are acquired on exercise. LEPOs are also available on selected indexes.
Characteristics	<ul style="list-style-type: none"> • Margins paid • Relatively high premium • A low exercise price • Relatively low outlay • Ongoing margins are payable.
Underlying shares	A complete list is available on our website www.asx.com.au/options
Contract size	100 shares per contract, subject to usual adjustment for rights, bonus issues and other capital adjustment events or \$10 times the underlying trade.
Contract months	Same expiry months as Exchange Traded Options
Benefits	<ul style="list-style-type: none"> • Leverage • Cash efficient • No risk of early exercise • Physical delivery of shares on exercise • Good proxy for share trading • Ease of account opening • Availability of offsets on some margins • Ability to lodge non-cash collateral.
Suitable for	Experienced investors who understand and accept the risks associated with leverage and derivatives.
Risks	<ul style="list-style-type: none"> • Leverage • Margin calls

LEPOs, namely low exercise price options, even though being options, behave like futures contracts since their exercise price is extremely low, meaning that they are deep in-the-money call options.

- (b) How would you use options to manage this risk? Plot a payoff diagram of your strategy. What options contracts are available for this?

You could buy put options, which is a strategy called **portfolio insurance**. Again, assume that 1 put option is over 1 unit in the ETF and your hedging date matches the expiry date of the put. Also let $K = \$50$. Again, your position at expiry is the sum of your ETF holding plus the put payoff: $S_T + \max\{0, K - S_T\}$.



You could use **S&P/ASX 200 Index Options** or possibly ETP options over the ETF if one exists.

[S&P/ASX 200 index options XJO](#)

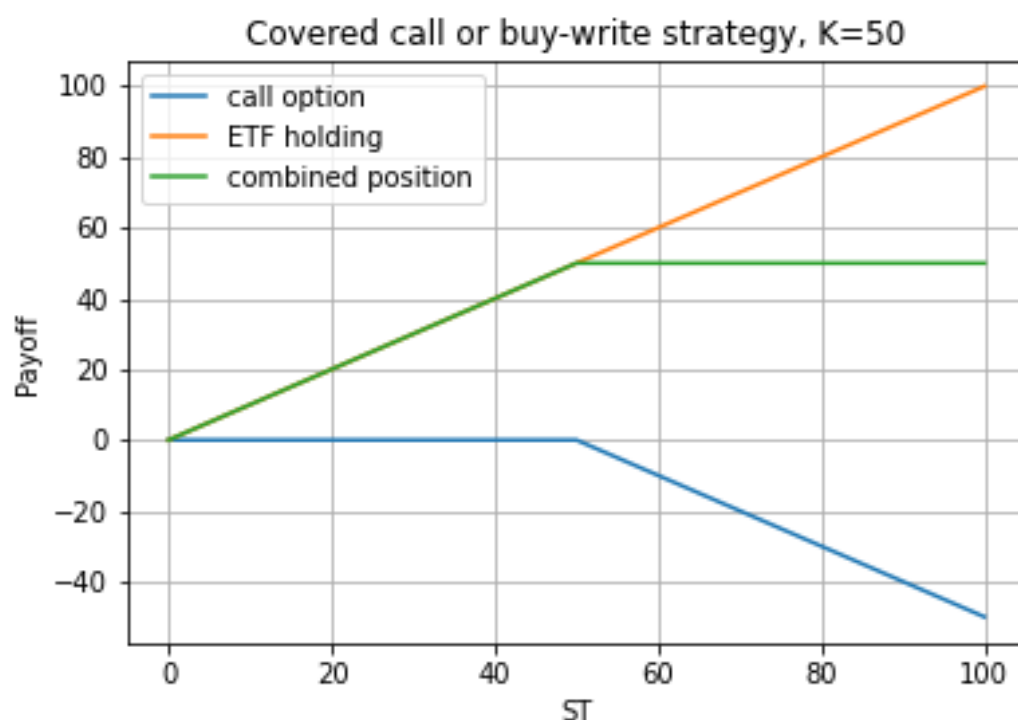
Underlying index	S&P/ASX 200 index
Security codes	The first three characters are the ASX code e.g. XJO, the fourth and fifth characters are the clearing code randomly assigned by ASX. Certain codes include a sixth character which is always numeric.
Index multiplier	\$10. Each index point is equal to AUD \$10.
Tick size	Quoted as the number of points of the index. (Tick size 1.0 point)
Exercise style	European, ie. exercisable only on expiry day.
Exercise intervals	25 Index points
Type	Call and put options
Contract months	March, June, September, December up to six quarter months ahead and serial months up to four non-financial quarter months ahead
Expiry day	Monthly Contracts - The third Thursday of the contract month, unless otherwise specified by ASX. Weekly Contracts - Thursday, unless otherwise specified by ASX.
Last trading day	Trading will cease at 12 noon on expiry Thursday.
Trading hours	9.50am to 5.00pm and 5.30pm to 7.00pm (Sydney time)
Settlement	Index options are cash settled using the opening price index calculation on expiry morning. This means trading will continue after the settlement price has been determined.
Settlement day	The first business day following the Last Trading Day

ETP options

Underlying security	Any ETP approved by ASX under guidelines for listing equity options
Security code	The first three characters are the ASX code eg. STW, the fourth and fifth character are the clearing code which is randomly assigned by the ASX. Some codes will include a sixth numerical character which is a clearing code randomly assigned by ASX.
Contract size	Normally 100 securities per contract.
Tick size	\$0.001 per share = \$0.10 (contract size 100 shares) for premium below 1 cent. \$0.005 per share = \$0.50 (contract size 100 shares) for premium of 1 cent or more.
Exercise style	European (Exercisable on the expiry date only)
Exercise price	Generally set by ASX Clear subject to strike price intervals.
Type	Call and put options
Contract months	As detailed in equity options expiry calendar
Expiry date	Monthly Contracts - 3rd Thursday of the calendar month. Weekly Contracts - Thursday Both may change due to public holidays
Trading hours	Normal trading 10.00am to 4.20pm (Sydney time). Late trading 4.20pm to 5.00pm and overseas trading in accordance with the ASX Market Rules
Settlement	Physical delivery of underlying security

- (c) What is the payoff diagram if you sold a call option on your ETF whose strike price equals the value of your holding? Why would you do this?

This is a common strategy known as a **covered call** or a **buy-write**. Again, the payoff is your combined ETF holding and short call payoff: $S_T - \max\{0, S_T - K\}$.



Why would you do it? You're expecting the market (your ETF price) to go sideways (remain relatively unchanged) and you generate additional income on your ETF holding via the option premium (again, note that the premium is not included since these are payoff diagrams).

```

1 import numpy as np
2 import matplotlib.pyplot as plt
3
4 K=50
5
6 ST=np.linspace(0,100,1001)
7
8 long_forward=ST-K
9 short_forward=K-ST
10 long_call=np.maximum(0,ST-K)
11 long_put=np.maximum(0,K-ST)
12
13 futures_hedge=ST+short_forward
14
15 portfolio_insurance=ST+long_put
16 buy_write=ST-long_call
17
18 plt.figure()
19 plt.plot(ST,long_forward, label='long forward')
20 plt.plot(ST,long_call, label='call option')
21 plt.grid()
22 plt.legend()
23 plt.xlabel("ST")
24 plt.ylabel("Payoff")
25 plt.title("Long futures and call option, K=50")
26
27 plt.figure()
28 plt.plot(ST,short_forward, label='short forward')
29 plt.plot(ST,long_put, label='put option')
30 plt.grid()
31 plt.legend()
32 plt.xlabel("ST")
33 plt.ylabel("Payoff")
34 plt.title("Short futures and put option, K=50")
35
36 plt.figure()
37 plt.plot(ST,short_forward, label='short forward')
38 plt.plot(ST,ST, label='ETF holding')
39 plt.plot(ST,futures_hedge, label='combined position')
40 plt.grid()
41 plt.legend()
42 plt.xlabel("ST")
43 plt.ylabel("Payoff")
44 plt.title("ETF holding hedged with short futures, K=50")
45
46 plt.figure()
47 plt.plot(ST,long_put, label='put option')
48 plt.plot(ST,ST, label='ETF holding')
49 plt.plot(ST,portfolio_insurance, label='combined position')
50 plt.grid()
51 plt.legend()
52 plt.xlabel("ST")
53 plt.ylabel("Payoff")
54 plt.title("Portfolio insurance strategy, K=50")
55
56 plt.figure()
57 plt.plot(ST,-long_call, label='call option')
58 plt.plot(ST,ST, label='ETF holding')
59 plt.plot(ST,buy_write, label='combined position')
60 plt.grid()
61 plt.legend()
62 plt.xlabel("ST")
63 plt.ylabel("Payoff")
64 plt.title("Covered call or buy-write strategy, K=50")

```


Question 2. What are the differences between OTC markets and trading venues? What is a trading venue? What is a multilateral trading facility (MTF) and what are some examples? What is an alternative trading system (ATS) and what are some examples? How do they compare to traditional exchanges? What is a central counterparty clearing house (CCP) and what are some examples?

[Investopedia](#) and [wiki](#) have pretty good discussions of OTC markets. Some descriptions of trading venues could include:

- *“A system or electronic platform operated by an investment firm or a market operator which brings together buying or selling interests of counterparties in financial instruments to perform a transaction.”*
- *“Trading venues can be defined as regulated and authorised facilities where securities are traded, and includes, among others, Multilateral Trading Facilities (MTFs) and regulated markets such as stock exchanges. The execution of trades on a trading venue can only be performed by authorised members of a trading venue.”*
- *“The term trading venue refers to a system and service in which buy and sell orders for the securities and/or derivatives of multiple parties are matched. Trading venues include regulated markets (stock exchange), multilateral trading facilities (MTF) and organised trading facilities (OTF).”*
- *“The more well known venues are generally the main segments of major exchanges such as Euronext Amsterdam or the London Stock Exchange. However, these are not the only venues where financial instruments are traded. Financial instruments can also be traded on alternative trading venues such as the BATS, Chi-X or IEX markets, between individual market makers, or ‘Over the Counter’ (OTC).”*

Here’s an interesting [list of global trading venues](#), and an explanatory table:

	Regulated Market (RM)	Organised Trading Facility (OTF)	Multilateral Trading Facility (MTF)
Features	<ul style="list-style-type: none"> - Operated by market operator - Authorised by NCA under MiFID II (Title III) as regulated market - No discretion in execution - Examples: London Stock Exchange, Euronext London, Cyprus Stock Exchange 	<ul style="list-style-type: none"> - Not an RM or MTF - Authorised by NCA under MiFID II (Title III) as investment firm - Interests in bonds, structured finance products, emission allowances or derivatives - Has discretion in execution - Examples: Cube Investing, Mariana Capital, Reyker 	<ul style="list-style-type: none"> - Operated by investment firm or market operator - Authorised by NCA under MiFID II (Title III) as investment firm - No discretion in execution - Examples: UBS MTF, Sigma X
Restrictions	<ul style="list-style-type: none"> - Cannot deal on own account - Cannot act as matched principal 	<ul style="list-style-type: none"> - Cannot deal on own account - Cannot act as matched principal in limited circumstances - Need to be licensed - Conduct of business requirements 	<ul style="list-style-type: none"> - Cannot deal on own account - Cannot act as matched principal

For MTFs, you could consider the [wiki](#), [Investopedia](#) and [CFI](#) discussions. For ATFs, also consider the [wiki](#), [Investopedia](#) and [CFI](#) discussions. For CCP consider [wiki](#) and [Investopedia](#), as well as these Clearstream links ([1](#) and [2](#)), and note that the ASX provides CCP services (see [1](#), [2](#), [3](#), [4](#), [5](#)), as do many traditional exchanges globally (consider [HKEX](#)). A lot of these changes and innovations in financial markets are due to the GFC and consequent changing regulatory environment, and they blur the distinction between OTC markets and traditional exchanges. The main point of the question is that nowadays an increasing portion of financial market trading occurs on what would be considered “less traditional” trading venues, instead of the major exchanges. Many of these less traditional trading venues are specialised and targeted at particular types of trading (e.g. algo/HFT/automated/computerised etc).

Question 3. 1. You run a bank that is mostly invested in long duration US Government bonds, but mostly financed by retail demand and term deposits. What is your interest rate exposure here? How might you use interest rate swaps to manage this exposure?

You're exposed to the risk of increasing interest rates, which reduce the value of your assets (bond portfolio), don't increase your income (since your bond portfolio is fixed rate US Government bonds), but increase your cost of funds, hence squeezing your interest rate margin/spread. (Does this scenario sound familiar and relate to a question below?) You could use fixed-for-floating interest rate swaps in which you receive floating and pay fixed. Here, if interest rates increase, you'll receive positive cashflows on each interest date from your swap position, improving your margin.

2. Your business raised a significant amount of debt financing at fixed interest rates over 2024 and you think interest rates might start decreasing now. How might you use interest rate swaps here to get more favourable borrowing costs if your view does turn out to be correct?

In this case you could use fixed-for-floating interest rate swaps in which you receive fixed and pay floating. If interest rates decrease, you'll receive positive cashflows from your swap position. Note that we'll talk more about swaps later in the course. The purpose of this question is to get you to start thinking about and looking into them, in particular because based on the market statistics presented in the lecture notes, OTC interest rate swaps dwarf all other markets in terms of notional principal outstanding.

Question 4. Your business just sold off a major offshore division and will be paid in the foreign currency in 1 month. You intend to immediately exchange the foreign currency to your domestic currency. What is your exchange rate exposure here? How would you use currency forwards to manage this exposure?

You're exposed to the foreign currency depreciating against your domestic currency (equivalently, your domestic currency appreciating). You would simply enter into a forward contract fixing the exchange rate at which you trade the foreign currency for domestic currency in 1 month. Note that by doing this, you'll forgo a potential appreciation in the foreign currency, which would give you more domestic currency on your transaction date. But is the decision to not hedge in fact actually a decision to speculate?

Question 5. What was LIBOR and where did it go? What was its role in financial markets? What are its proposed replacements? What are some other global reference rates that play a similar role to LIBOR? What are their interest rate quoting conventions: What maturities are quoted? Are they discount rates, simple interest or discrete compound interest? What day count conventions do they use?

LIBOR was a group of global reference rates in various currencies with which many financial securities including derivatives were priced. It was abandoned due to a scandal and various replacements are now used. See the discussion at [here](#) and [here](#), as well as [here](#) and [here](#) for the scandal. Consider looking at the <https://www.euribor-rates.eu/en/> and <https://www.global-rates.com/en/> websites. Consider the discussions of SOFA [here](#) and [here](#) and [here](#) and [here](#) and [here](#) (this last link is to the CME Group and you can set up a free login to get Term SOFA rates), of EURIBOR [here](#) and [here](#), of ESTR [here](#) and [here](#), and of SONIA [here](#) and [here](#). These and other global reference rates are central to financial markets, particularly derivative securities. Other useful websites are <https://www.worldgovernmentbonds.com/> and <https://www.yieldreport.com.au/>. In Australia, consider the Bank Bill Swap Rate (BBSW), say [here](#) and [here](#) and [here](#) and [here](#), which is the main reference rate used in Australia. It would be useful for you to look into and understand the difference between (i) overnight rates, (ii) backwards looking compounded average rates and (ii) forward looking term rates (swap rates, Term SOFA, EURIBOR, etc). Here's a useful BIS Quarterly Review paper of the post-LIBOR world, which contains the below table: [The post-Libor world: a global view from the BIS derivatives statistics](#).



Table 1



Close all

Summary of different reference rates

Table 1

Rate	Based on	When known	Backward- or forward-looking	Examples
Libor	Quotes	At the start	Forward-looking	<i>Unsecured:</i> USD/EUR/GBP/JPY/CHF Libor
O/N RFR	Transactions			<i>Unsecured:</i> ESTR, SONIA, TONA <i>Secured:</i> SOFR, SARON
Compounded RFR in arrears	Transactions	At the end	Backward-looking	
Compounded RFR in advance	Transactions	At the start	Backward-looking	
Term RFR ¹	Quotes and transactions	At the start	Forward-looking	<i>Secured:</i> CME Term SOFR
Other term rates	Quotes and transactions	At the start	Forward-looking	<i>Unsecured:</i> Euribor, Tibor, BSBY, Ameribor
Other O/N reference rate	Quotes and transactions			<i>Unsecured:</i> EFFR, EONIA

O/N = overnight.

¹ By market convention, only forward-looking term RFRs based on derivatives are referred to as "term RFRs".

Source: Authors' elaboration.

© Bank for International Settlements

Question 6. What went wrong at Silicon Valley Bank (SVB)? Why did depositors run on the bank? What market risk was SVB exposed to and possibly didn't manage well? In hindsight what would you recommend they have done differently?

Questions 6 to 8 are general discussion and debate questions. There are entire university courses presented and books written on these topics. Everyone has a different opinion of what happened and these opinions are often (well, usually) highly politically charged and motivated. Of course, watching *The Big Short* is compulsory for a derivatives and risk management course! ;-)

Question 7. What was the 2008 global financial crisis and what were its impacts on financial markets and the economy? What kind of risks did it present to businesses and how might you think about managing those risks? What impact did it have on OTC market regulation? Have you watched *The Big Short*? What is your view on the cause of the GFC?

Question 8. What happened at Long Term Capital Management (LTCM)? What were some of the derivatives trading strategies that LCTM employed? Who were the principal people behind LCTM - are some names familiar? What were the market movements that they didn't expect and brought them down?

- Question 9.** 1. What are the main trading venues that trade derivative securities in your home country?
2. What are the main contracts traded on these venues?
 3. What are the contract specifications of these contracts?
 4. As a retail trader, how can you access trading these derivative securities?
 5. Who are the main financial market regulators in your home country?
 6. Who are the main industry associations and bodies?
 7. Can you find any information or statistics on OTC derivative market activity in your home country?
 8. Who are the main financial institutions active in derivative security markets (and potential future employers for you) in your home country?

This question is for your own interest and future career success!