Table 2: Typical liabilities of banks.

	Proportion of assets (%)
Sight deposits (current accounts)	10 - 40
Time deposits (saving accounts)	10 - 50
Money market borrowing (repos, interbank)	10- 40
Bank capital (equity)	5 - 15

Source: Arnold (2014)

In the event of a bank failure, not only the bank owners, but also the depositors sustain a loss. That is why the depositors have to be protected. Since banking and the banking system are based on trust, a bank failure might trigger a chain-reaction that – in extreme cases – might also jeopardise the stability of the banking system. There are several risks associated with banking activity. Table 3 provides an overview.

Table 3. Overview of the main types of risk.

Risk type	**Definition / Main characteristic**
credit risk	the risk that a borrower will fail to meet its obligations in accordance with agreed terms
operational risk	the risk of loss resulting from inadaquate or failed internal processes, people and systems or from other external events
market risk	the risk that the value of an investment will decrease due to changes on the financial market / in market factors
liquidity risk	the risk that over a specific horizon the bank will be unable to settle obligations when due
systemic risk	the risk that an event will trigger a loss of economic value or confidence in a substantial portion of the financial system

Interest rate risk or interest risk is defined as *a negative effect on the cash flow of the bank from changing interest rates*. Interest rate risk derives from the case, that the interest rate sensitivity of the bank's assets and liabilities are different. An asset (e.g.: loan) or a liability (e.g.: term deposit) is interest rate sensitive, if the pricing can change during a specified period. At the expiration of a specific asset or liability the environment might change and consequently the conditions of the new assets or liabilities also change.

For example, if the bank is financing a certain fixed rate asset (e.g.: 5-year maturity, fixed rate mortgage loan) from a floating rate liability (e.g.: 1 year term deposit), after the expiration of the liability, an increase in interest rates has an unfavourable outcome for the bank's income. Interest rate risk can be managed by synchronising the expiration time of the certain assets and liabilities. This means that the interest rate sensitive assets are financed from interest rate sensitive liabilities.

Interest rate risk can be measured by several methods. One of the simplest risk assessment method is the interest gap analysis. The formula:

$$GAP_t = RSA_t - RSL_t \quad (1)$$

where: GAP: interest rate GAP during the given period
RSA: interest rate sensitive assets
RSL: interest rate sensitive liabilities

Example: Calculating interest rate risk
The GAP Bank's balance sheet consists of fixed and floating rate EUR loans and on the liabilities side fixed and floating rate EUR term deposits. Interest rate income is calculated by the difference of the interest revenue received from the loans and the interest expenses paid to the depositors.

TABLE 4: BALANCE SHEET OF GAP BANK.

GAP Bank			
Assets (million EUR)		***Liabilities (million EUR)***	
Loan (fixed rate)	200	Deposit (fixed rate)	100
Loan (floating rate)	300	Deposit (floating rate)	400

Assuming, that initially the loan's interest rate is 10% and the deposit interest rate is 5%, the bank's income is evaluated by the following method:

Interest rate income	**Amount**	**Interest rate**	**Interest**
Loan (fixed)	200	10%	20
Loan (floating)	300	10%	30
Sum			**50**
Interest rate expenses			
Deposit (fixed)	100	5%	5
Deposit (floating)	400	5%	20
Sum			**25**
Net income			**25**

As a result of the calculation the interest income of the bank is 25 million EUR.
Using the GAP formula:

$$RSA_t = 400,\ RSL_t = 300 \ \rightarrow \ GAP_t = 300 - 400 = -100$$

Assuming that the interest rate increases 100 basis points, the banks interest revenue and expense from fixed rate loan and deposit remains unchanged, however the revenue and expenses from the floating rate deposit and loan changes, as the table shows below:

Interest rate income	**Amount**	**Interest rate**	**Interest**
Loan (fixed)	200	10%	20
Loan (floating)	300	11%	33
Sum			**53**
Interest rate expenses			
Deposit (fixed)	100	5%	5
Deposit (floating)	400	6%	24
Sum			**29**
Net income			**24**

In this case the bank's interest income decreased by 1 million EUR. As a consequence of an interest rate raise the bank's profit will be lower than initially when the base rate was 5%. The fact that the bank holds more interest rate sensitive assets than liabilities results a decreasing interest income, after raising the base interest rate.

The change of income triggered by the change of the interest rate can be calculated as follows:

$$\Delta y = \Delta i * GAP \qquad (2)$$

where Δy is the change of income, and
Δi is the change of the interest rate

In the above example:
$\Delta i = +1\,\%\,,\ GAP = -100 \ \rightarrow\ \Delta y = 1\% * (-100) = -1$

Table 5 sums up the relation between the GAP and the interest rate risk.

TABLE 5: THE EFFECT OF GAP ON THE INTEREST RATE INCOME.

	positive GAP	negative GAP
increasing rates	**+**	**-**
decreasing rates	**-**	**+**

4.4 Banking regulation

Comparing to other companies in the real economy, banks operate with a much higher leverage. Moreover, information asymmetry is also typical for the banks and their customers. Information asymmetry means that the banks and the clients do not have the perfect information about each other. Because of the risks and risky activities the probability of bank failures is high. The avoidance of the bank failure is one of the main purposes of the regulatory authorities. That is why banks have to comply with regulations that essentially relate to capital, liquidity and risk-taking.

Banking regulation is complex since it is determined by legal, institutional and cultural factors. Despite of different national and regional characteristics, an international cooperation can be observed in banking regulation.

The ***Basel Committee on Banking Supervision*** (BCBS) is *the primary global standard setter for the prudential regulation of banks and provides a forum for regular cooperation on banking supervisory matters*. Its mandate is to strengthen the regulation, supervision and practices of banks worldwide with the purpose of enhancing financial stability. As far as its legal status is concerned, BCBS does not possess any formal supranational authority and its decisions do not have legal force. The BCBS relies on its members' commitments. However, the banking regulation practices of the major economies in the world are generally in line with regulatory packages of the BCBS. These regulatory packages are known as Basel I, Basel II and Basel III. Table 6 illustrates the development of risk measurement in the different regulatory packages of BCBS.

TABLE 6: THE EVOLUTION OF RISK MANAGEMENT.

Types of risk	Basel I (1988)	Basel II (2004)	Basel III (2010)
Credit risk	✔	✔	✔
Operational risk	✖	✔	✔
Market risk	✖	✔	✔
Liquidity risk	✖	✖	✔
Systemic risk	✖	✖	✔

The ***Basel Capital Accord*** of 1988 or simply Basel 1 *established an international standard around capital ratio of 8 per cent on credit risk*. There are four risk classes in the risk-weighted system related to credit risk exposure. Table 7 summarises the framework for capital adequacy risk weighted assets.

TABLE 7: RISK-ASSET RATIO APPROACH IN BASEL I.

Risk class	Weight	Example
No risk	0%	cash, bonds issued by OECD governments
Low risk	20 %	short term claims
Moderate risk	50 %	mortgages
Standard risk	100 %	commercial loans

According to this approach, the banks have to hold a minimum capital that is more than 8% of the total risk-weighted assets (RWA).

This method ignores other types of risk that banks face.

Example: RWA in Basel I
Let us take a bank with the following assets in its balance sheet:

- *cash:* 100 million EUR
- *governments bond*: 100 million EUR
- *interbank loans* (loans to other banks): 500 million EUR
- *mortgages:* 600 million EUR
- *commercial loans:* 1200 million EUR

In this case, the minimum capital ratio should be calculated as follows:

Assets	Risk class	Weight	Quantity	risk-weighted value
cash	No risk	0%	100	0
goverments bond	No risk	0 %	100	0
interbank loans	Low risk	20 %	500	100
mortgages	Moderate risk	50 %	600	300
commercial loans	Standard risk	100 %	1200	1200

As the value of risk weighted assets is 1600 million EUR the minimum capital the bank must hold is 8% x 1600 million EUR = 128 million EUR.

Basel II uses a *„three pillars" concept*:

minimum capital requirements
It deals with maintenance of regulatory capital calculated for credit risk, operational risk and market risk

supervisory review
Supervisors are supposed to control the banks' risk frameworks

market discipline
It encourages effective disclosure about risk exposure, capital adequacy and risk assessment processes

Basel II uses a more risk-sensitive approach and the biggest changes relate to the calculation of minimum capital requirements for credit risk. Since market risk and operational risk are taken into consideration in Basel 2, the minimum capital requirements should be calculated as follows (BCBS, 2014):

$$\frac{\textbf{Total capital}}{\textbf{Credit risk + Market risk + Operational risk}} = \textbf{The bank's capital ratio (8\%)}$$

The third instalment of the Basel Accords or ***Basel III*** was developed in response to the problems in financial regulation revealed by the 2008 financial crisis. Basel III is *intended to strengthen bank capital requirements by increasing bank liquidity and decreasing bank leverage*.

Basel III build upon the Basel II three pillar approach and all the pillars are strengthened, especially the first pillar due to the enhanced minimum capital and liquidity requirements. Basel III introduced two liquidity ratios:

- *Liquidity Coverage Ration (LCR) and*
- *Net Stable Funding Ratio (NSFR).*
-

FIGURE 4. LIQUIDITY AND LEVERAGE RATIOS IN BASEL III.

$$\textbf{LCR} = \frac{\textbf{Stock of high quality liquid assets}}{\textbf{Total net outflows over the next 30 calendar days}} \geqq 100\,\%$$

$$\text{NFSR} = \frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} \geqq 100\,\%$$

$$\text{Leverage ratio} = \frac{\text{Capital measure}}{\text{Exposure measure}}$$

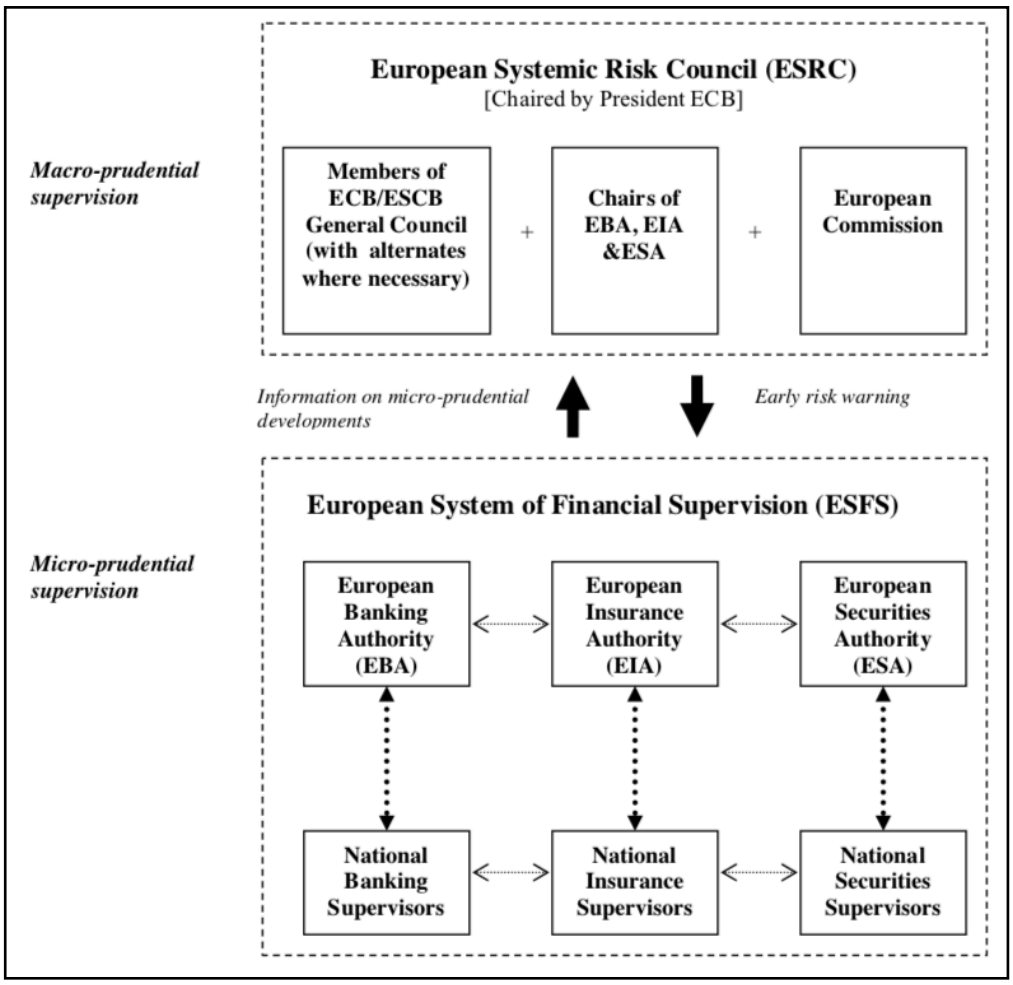
Source: BCBS, 2014.

There were significant changes in banking regulation after the financial crisis of 2008. A new regulatory system was established in the European Union after the crisis. The European System of Financial Supervision (ESFS) was introduced in 2010. It consists of: the European Systemic Risk Board (ESRB) and three European supervisory authorities (ESAs), namely:

- *the European Banking Authority (EBA)*
- *the European Securities and Markets Authority (ESMA)*
- *the European Insurance and Occupational Pensions Authority (EIOPA).*

Whilst the national supervisory authorities remain in charge of supervising individual financial institutions, the objective of the European supervisory authorities is to improve the functioning of the internal market by ensuring appropriate, efficient and harmonised European regulation and supervision. Figure 5 provides an overview of the new regulatory system.

FIGURE 5: THE NEW EUROPEAN FRAMEWORK FOR FINANCIAL STABILITY.



Source: European Economic and Social Committee (2009)

The financial crisis of 2008 made it clear that the harmonisation of supervisory practices and better coordination among the regulatory agencies is needed. The transformation of the new European framework serves this purpose.

As far as banking regulation is concerned, the European Banking Authority has an important role. The main task of the EBA is to contribute to the creation of the European Single Rulebook in banking. Its objective is to provide a single set of harmonised prudential rules for financial institutions throughout the European Union. EBA also plays an important role in promoting convergence of supervisory practices and is mandated to assess risks and vulnerabilities in the EU banking sector.

The European Central Bank has also a central role in the new supervisory system. After the crisis, the regulatory approach has changed with regard to central banks. In addition to taking into account price stability considerations, central banks pay more attention to financial stability and growth considerations. While the pre-crisis period separated the regulation of individual market players from the market as a whole, macroprudential supervision is aimed at reducing market-level risk for the market as a whole.

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CHAPTER 5 *SECURITIES MARKETS*

5.1. Basic terms

Financial assets or securities (unlike cars and houses) *are intangible assets in the sense that their value does not depend on their physical characteristics*. Moreover, in most of the cases, they even do not have any physical attributes, since they are electronic, dematerialised. (Some financial assets, called certified securities, are issued in printed form, but the value of these instruments has still no connection with the quality of the paper or the ink.)

> Financial assets and securities are not precisely the same; the former term usually refers to a broader group. However, the legal definitions may vary by countries, and discussing these differences is beyond the scope of this book.

The most important common feature of financial assets is that they are *claims and, at the same time, obligations on future cash flows*. (Here we refer to Chapter 2 where we recognised that financial goods always appear in two balance sheets simultaneously: a future cash flow can be a claim for somebody only if it is an obligation for somebody else.) Hence, when determining the value of a financial asset, we have to calculate the present value of its future cash flows. This is why present value calculation is so important in finance. We remark that these valuations might be very complicated, for two reasons. First, the nominal sums of the future cash flows are not necessarily determined in advance (e.g., dividends of a stock). Second, the appropriate rate for discounting might be hard to find.

It is worth to observe that not only financial assets can be the subject of investment. We can invest our money in oil, paintings, real estate, and so on. A derivative contract (see Chapter 5.5) on oil is a financial asset, but one barrel of Brent oil is not.

As for the basic features of the claim embodied, we can talk about debt and equity instruments. Bonds and loans are typical examples of ***debt instruments***; t*heir holders require fix payments* (i.e., payments not depending on the economic performance of the borrower) *in return of lending funds*. ***Equity instruments*** - common stocks, for example - *promise payments dependent on the earnings of the issuer and paid after all debt instrument holders are paid*. Because of this, equity instruments are also called residual claims.

Financial markets are markets *where financial assets are issued and traded*. Different aspects might group these markets. According to the products traded, we can talk about debt, equity, derivatives, etc. markets. As for the tenor of the investments, we distinguish between the ***money market and the capital market***: t*he former is the market for short-term* (i.e. shorter than 1 year) *financial assets, the latter is for long-term assets*. The ***primary market*** i*s the expression for new issuances*, while the ***secondary market*** i*s where already issued assets are traded over*. Finally, it is important to mention that the "place" of the trading might be an exchange or the so-called over-the-counter (OTC) market. Several securities are traded in both; moreover, some stocks are listed in more exchanges at the same time.

5.2. Bond markets

Bonds are *debt instruments* similar to loans: the issuer is the debtor, the investor or the buyer of the bond is the lender. The issuer *promises to pay the interest and the nominal or face value of the security in the future*. However, there are at least two significant differences between loans and bonds. First, bonds are traded securities, which means that the 'lender' does not have to keep the asset until maturity, he can sell it on the secondary market. Second, the interest rate that the bond pays - also called coupon rate - is not necessarily equal to the return expected by the investors. Because of this, the loan amount that the issuer receives initially and that he pays back at maturity might be different.

The future cash flows of a bond can be determined according to the following five parameters: face value, coupon rate, interest payment period, principal payment schedule, time to maturity. The ***face value*** (or nominal value) is *the amount the issuer has to pay back* to the lender in the form of principal payments. The ***coupon rate*** of the bond is always expressed as *an annual percentage of the outstanding face value*. If the interest payment period is shorter than one year, we calculate the time-proportional interest linearly. The interests might be paid annually, semi-annually, quarterly, and so forth. In the case of government bonds, annual and semi-annual interest payments are the most frequent. The simplest and most usual principal payment schedule is when the entire face value is paid in one sum, at maturity. In this case, we call the instrument bullet bond, while in the case of more, partial principal payments, we call it amortising bond.

Example: cash flows of 4-year bonds with different cash flow schemes
Consider four bonds: A, B, C and D. For all of them, the face value is 1,000 EUR, the coupon rate is 4% and the time to maturity is 4 years. A, B and C pay interest annually, D pays semi-annually. A and D are bullet bonds, B and C are amortising bonds. Bond B repays the face value in two parts at the last two cash flow dates, in 20-80% proportion. Bond C pays equal principal payments during the 4 years.

TABLE 1: CASH FLOW SCHEMES OF 4-YEAR BONDS

Year*	A	B	C
1	40	40	290
2	40	40	280
3	40	240	270
4	1,040	832	260

Year*	D
0.5	20
1	20
1.5	20
2	20
2.5	20
3	20
3.5	20
4	1,020

**Year = the period that has to pass for the CF to be paid, expressed in years*

It is worth to mention that the coupon rate of a bond can be fixed or floater. In the first case, the coupon is constant over time and determined at issuance – this was the case in the previous example. Floater bonds pay interest that varies according to a reference rate. This reference rate is usually an interbank rate like Libor or Euribor. In the case of floater bonds, it is only the next cash flow that we know in advance.

Example: cash flows of a 5-year floater bond
A floater bond pays interest annually, the coupon is the 12-month USD Libor + 30 bps. At issuance, the Libor is 3.0%, so the first interest payment of the bond is fixed at 3.0% +0.3%=3.3%. The second payment will be fixed at the end of the first year, and so on (see Table 2). At maturity, the last coupon payment and the face value is paid as well. You can observe that the payments follow the market movements, which means that floater bonds bear less interest rate risk than fixed bonds. On the other hand, they carry cash flow risk which is excluded in case of the fixed securities. Hence, there is a trade-off between the two types of risk.

TABLE 2: CASH FLOWS OF A 5-YEAR FLOATER BOND

Year	CF*		Libor
0			3.0%
1	3.3		2.5%
2	2.8		2.9%
3	3.2		2.5%
4	2.8		2.0%
5	102.3		

**CF=cash flow that the bond pays at the end of the given year (expressed in percentage of the face value.)*

Finally, we have to mention some special types of bonds, those with embedded options. Convertible bonds give the right to the holder to exchange his bond to the stocks of the issuer company. These are instruments half-way between debt and equity. Callable bonds grant the right to the issuer to "call back", that is to repay the bond's face value before maturity. In the case of putable bonds, the holder has the right to "give back" the instrument to the issuer, that is to enforce the redemption before maturity. In all of these cases, the proper conditions of exercising the options must be determined in advance.

5.3. Credit rating

The most significant issuers of bonds are central governments. Others are local governments, financial institutions, and companies. Corporate bonds are more common in the US than in Europe.

Central governments issue bonds to finance their budget deficit. In the US, the issuances are organised by the Department of the Treasury. The most important types of securities in this market are T-bills, T-notes, and T-bonds. (T stands for Treasury.) T-bills are money market instruments, with 12-month maturity at most. These securities do not pay any interest, so they have only one cash flow: the face value at maturity. In case of positive discount rates, their price is under their face value and vice versa. T-notes and T-bonds are coupon-bearing instruments, with semi-annually interest payment period. T-notes are medium-term assets, T-bonds are issued with at least 10 years of maturity. We may observe that in the case of the US Treasury securities, only the longest instruments are called bonds. However, the economic and financial sense of bills and notes are the same, and they belong to the same broader class of financial assets. It is quite general that the money market securities of the central governments are zero-coupon instruments, and that they have a distinct name.

Government bonds are often called risk-free instruments, since governments (countries) cannot go bankrupt. This is a very simplistic statement, for two reasons. First, we have to

clarify that in this statement risk refers exclusively to credit risk, that is to the risk that the issuer is not able or not willing to pay its obligations. There are several other types of risk that a bondholder may take, the most important being the interest rate risk. Second, sovereign defaults occurred more frequently and in more countries than one might think - not only in South America, not only after military coups, not only in foreign currency, not only with very high debt/GDP ratio. However, we admit that government bonds issued in local currency are usually the safest investments within a country, concerning credit risk.

Table 3: The Credit Rating categories of fitch

	Category	Short description
Investment grades	AAA	Highest credit quality
	AA	Very high credit quality
	A	High credit quality
	BBB	Good credit quality
Speculative grades	BB	Speculative
	B	Highly speculative
	CCC	Substantial credit risk
	CC	Very high levels of credit risk
	C	Near default
	RD	Restricted default
	D	Default

Source: Fitch (2018)

Credit risk is a risk-type that is hard to measure. Specialised knowledge and expert is needed, and the data required for the calculations might not be available for every single investor. That is why credit rating agencies specialised to this task. The most well-known agencies are Moody's Investors Service, Standard and Poor's (S&P) and Fitch Ratings. They use alphabetical categories to assess the credit risk of a given issuer. The categories are similar, but not exactly the same at the different agencies, see for example the grades of Fitch in Table 3.

We may observe that the four best categories are called investment grades, while the riskier ones are speculative – they are also called junk bonds. It is important to mention that the agencies are not prophets. Their ratings rely on sophisticated models, but these are still only models subject to mistakes.

5.4 Stock exchanges

The below description of stock exchanges is based on how the Xetra trading system works. Xetra is an all-electronic trading system, which was originally developed in the Frankfurt Stock Exchange, but has expanded to be used by various stock exchanges throughout Europe, including Hungary. The trading system combines "continuous trading" periods with "auction" periods. In the Budapest Stock Exchange there are "auctions" from 8:30 to 9:00 a.m. and from 17:00-17:05 p.m. to collect the orders and after that in two minutes an algorithm knowing later determines the opening and the closing price of the shares. But there could be midday auctions as well, which enables liquidity to be concentrated in the middle of the day.

To trade on the stock exchange the investor must open a securities account at a bank or at a brokerage firm. Both securities and cash can be placed on this account. The balance of the securities account is the value of the investor's portfolio. Investors do not trade directly with each other but through an intermediary who can be a dealer or a broker.

Dealers have their own securities accounts, from where they sell securities at the ask price, and buy securities at the bid price. Thus their profit is the difference between the two prices, the so called bid-ask spread. The bid-ask spread reflects the liquidity of the security: the more liquid a security is the narrower is the bid-ask spread.

Brokers do not have securities accounts, thus they do not trade on the stock market, instead they match the trade orders of investors. The most typical form of a trade order is the limit order, when the investor sets a price limit at which the given security can be bought or sold.

A buy (or bid) order of price 80, size 120 can be interpreted as follows: the investor wants to buy 120 shares for 80 or cheaper. A sell (or ask) order of price 85, size 50 is an order, where the investor wants to sell 50 shares for at least 85 per share.

Limit orders that have not been executed yet are collected in the order book. The trading can be continuous, in this case matching orders are executed immediately, thus the order book contains orders that cannot be matched, i.e. the best ask price is somewhat higher than the best bid price. ("Best" from the point of view of the other side.)

The order book below (Table 1A) contains the prices at which orders were given in a descending order. There is a one dollar difference between the best ask price (45) and the best bid price (44). These are the best prices because the cheapest price a share could be bought for is 45 at the moment, the highest price a share could be sold for is 44.

TABLE 1A: ORDER BOOK.

BID / ASK	PRICE	SIZE
ASK	47	110
ASK	46	45
ASK	45	34
BID	44	78
BID	43	23
BID	42	81

The order book can be rearranged to give a more transparent view of the demand and supply sides of the market (Table 1B).

TABLE 1B: THE ORDER BOOK REARRANGED.

BID (BUY) ORDERS		ASK (SELL) ORDERS	
SIZE	PRICE	PRICE	SIZE
78	44	45	34
23	43	46	45
81	42	47	110

To avoid price manipulation only a limited number of the rows is public, i.e. displayed by the trading system. Every new order (except stop orders) placed in the central limit order book is immediately examined to see whether it can be executed against orders on the other side of the order book. Depending on the price limit of the incoming orders and the orders in the order book, execution can be performed at different prices. Execution is performed in accordance with the time/price priority, i.e. the order with a higher buy limit and lower sell limit are executed first. Following execution of the orders, all transactions are published immediately. For each transaction, the price, volume are displayed.

The trading system combines continuous trading (described above) periods with auction periods.

The auction begins with the outcry phase, followed by price determination. In the meantime buy and sell orders are collected in the order book according to price/time priority without executing them. The price will be determined and the orders will be executed at a particular point in time. The outcry phase ends randomly to avoid price manipulation. At the end of auctions all executable orders are executed so, as to prevent a “crossed” order book, i.e. there are no purchase and sale orders that overlap in terms of price, enabling continuous trading to continue. All orders that were not executed remain in the order book. The auction price is determined in accordance with the principle of highest volume transacted. This means that the auction price is the price at which the highest executable order volume is evident.

Example 1: continuous trading

Table 2 shows a part of the order book at a moment of the continuous trading period. The [86;1398] on the bid side means that there are orders to buy 86 stocks at price of 1398 or less. The [1405;110] on the ask side means that there are selling orders of 110 stock at a minimum price of 1405.

TABLE 2A: EXAMPLE 1 - ORDER BOOK

BID		**ASK**	
Size	**Price**	**Price**	**Size**
120	1400	1405	110
86	1398	1407	140
210	1395	1410	320
134	1392	1411	80
340	1389	1414	75

What are the impacts of the following orders on the book? What transactions can be executed if any can be done at all?

➡ a limit selling order: price 1403, size 80
This is better for the buyers than the best sell offer so far, but still is not good enough. It enters the top row of the ask side of the order book and the selling offers so far slide down.

TABLE 2B: EXAMPLE 1 - CONTINUED

BID		ASK	
Size	**Price**	**Price**	**Size**
120	1400	1403	80
86	1398	1405	110
210	1395	1407	140
134	1392	1410	320
340	1389	1411	80
		1414	75

➡ a limit buying order: price 1403, size 100
At this time, a transaction is possible: since the top of the ask side is 1403, it can be matched with the new bid offer. Thus 80 stocks will be sold immediately, and the remainder will be placed at the top of the bid side.

TABLE 2C: EXAMPLE 1 - CONTINUED

BID		ASK	
Size	**Price**	**Price**	**Size**
20	1403	1405	110
120	1400	1407	140
86	1398	1410	320
210	1395	1411	80
134	1392	1414	75
340	1389		

➡ a limit buying order: price 1406, size 90
The 90 stocks will be sold. The price will be the previous one (1405) which was already in the order book according to the price/time priority.

TABLE 2D: EXAMPLE 1 - CONTINUED

BID		ASK	
Size	**Price**	**Price**	**Size**
20	1403	1405	20
120	1400	1407	140
86	1398	1410	320
210	1395	1411	80
134	1392	1414	75
340	1389		

In case of market orders traders give the quantity to be bought or sold but they do not specify the price, which means that the order must be executed at the best price(s) available. A market order to sell (to buy) is executed buy going down on the bid (ask) size of the order book.

Example 1 - continued

➡ *market order to sell 70 stocks*

This order will be executed immediately at the best prices which are on the top of the bid side: 20 shares will be bought / sold for 1403, 50 share for 1400.

TABLE 2E: EXAMPLE 1 - CONTINUED

BID		ASK	
Size	**Price**	**Price**	**Size**
70	1400	1405	20
86	1398	1407	140
210	1395	1410	320
134	1392	1411	80
340	1389	1414	75

Stop limit orders are conditional orders that can be executed after the market price have reached a predetermined value. In case of stop limit orders to buy, the trader sets an activation price (stop price) higher than the prevailing market price, because (s)he thinks that reaching the activation price gives the share an upward momentum. The investor's reasoning is based on some market analysis that will be proved or disproved by reality later. The stop limit order to buy gives a chance to the investor to trade according to his/her believes about the future conditional movements of the price.

Stop limit orders to sell are the reverse case: the investor sets an activation (stop) price lower than the prevailing market price, because (s)he does not want to sell until the market price is above this value. By this order (s)he can maximise the potential loss on the investment or can avoid a downward momentum triggered by reaching the stop price. (The existence of this sudden price drop is, of course undecided…)

Example 1 - continued

➡ stop limit order to buy: stop price 1450, price 1480, size 100

➡ stop limit order to sell: stop price 1398, price 1389, size 80

Neither of the above orders the order book until the market price reaches the given stop prices.

Example 2: Price determination at auction

After collecting the buy and sell orders the overlapping part of the order book looks like the below (Table 3A):

TABLE 3: THE ORDER BOOK AFTER THE AUCTION PERIOD.

Bid	Price	Ask
40	1380	120
70	1385	40
30	1390	90
100	1400	80
30	1405	70

First, quantities are accumulated at each side, based on the fact that a limit order to buy (to sell) can be executed at a lower (higher) price. Thus, the accumulation is top-down at the ask side, and bottom-up at the bid side. Now, at each price the possible tradable amount can be determined by taking the minimum of the appropriate cumulated bid and ask offers. The price at the end of the auction will be the one that maximises the traded quantity.

In this example two prices (1385 and 1390) apply for this maximum principle. As the trading system has to come up with only one price, a secondary optimisation is introduced over the prices that maximise the traded quantity. The "winner" is the price where the offered quantity that cannot be traded is minimal.

The prices where the highest transacted amount (160 stocks) can be executed are 1385 and 1390. The better one of them is 1385 because at this price there is only 70 stocks which could be transacted (there are orders to buy them at this price) but there are no selling orders to pair with them. At the price of 1390 there would be orders for 90 stocks which cannot be realised.

TABLE 3B: THE ALGORITHM DETERMINING THE AUCTION PRICE.

cum Bid	Bid	Price	Ask	cum Ask	Tradable *min[cum Bid; cum Ask]*	Cannot be realised *max[cum Bid; cum Ask] - - tradable*
270	40	1380	120	120	120	
230	**70**	**1385**	**40**	**160**	**160**	**70**
160	30	1390	90	250	160	90
130	100	1400	80	330	130	
30	30	1405	70	400	30	

The secondary optimisation could happen in other ways as well. For example, we could strive to achieve the higher price or the lower price movement. But the method of the Xetra trading system follows the method above so the auction price will be 1385. All cumulated asks below and at this price, and all cumulated asked over this price can be paired. From the 230 shares accumulated at the determined price 70 remains according to time priority. The order book after the execution of all orders (that could be paired) is shown by Table 3C and 3D.

TABLE 3C: THE ORDER BOOK AFTER THE AUCTION.

Bid	Price	Ask
40	1380	
70	**1385**	
	1390	90
	1400	80
	1405	70

TABLE 3D: THE ORDER BOOK AFTER THE AUCTION REARRANGED.

Bid		Ask	
Size	Price	Price	Size
70	1385	1390	90
40	1380	1400	80
		1405	70

5.5 Derivatives

A ***derivative*** is *a security whose value depends on the value of the underlying (asset)*. The underlying (asset) can be a share, a bond, some kind of commodity, foreign exchange, interest rate, a stock index, etc. Derivatives can be used for hedging and for speculation.

There are three groups of derivatives:

- *forwards,*
- *options,*
- *swaps.*

The ***forward contract*** *is a mutual commitment of two parties to buy/sell the underlying at a specified price (F_T) on some future date (T)*. The ***future contracts*** are *special type of forward contracts traded on organised exchanges* known as futures market. The value of the forward at maturity depends on the value of the underlying (S_T). The buyer of the forward is in long position, that is (s)he gains profit if $S_T > F_T$: (s)he pays for the underlying the forward price, and as (s)he can sell it immediately for the prevailing market price, the difference between the two prices is his/her profit or loss. The seller is in short position, (s)he gets the forward price and pays the market price. (See Figure 1 for graphical details.) Thus the joint profit of the two parties is always zero. This gives rise to pure cash settlement on the futures markets: the parties do not need to deliver the underlying asset physically, it is enough if the "looser" pays the appropriate amount (i.e. the absolute value of the difference between the futures price and the market price at maturity) to the "winner".

> In the case of having a LF(K=500) and a SF(K=800) position with the same maturity (T) the investor will have income of 300 at the maturity of the contracts. If the transaction costs of the contracts are lower than the present value of the 300, then the investor can get risk-free profit which means that there are discrepancies in the market creating the possibility of an arbitrage.

Futures contracts and markets have further specialties. Considering that one of the goal of the financial markets is to concentrate demand and supply, the future contracts are

standardised, which implicates higher trading volume and lower trading cost. On the futures markets counterparties do not make the deal with each other. The ***clearing house*** *is an intermediary between buyers and sellers ensuring that the transaction happens as planned*: the clearing house buys the underlying and pays the seller even if the buyer refuses to pay, and vice versa. The payable fee for this service is low because of the risk mitigation by the margin accounts. Each investor agreeing the contract has a margin account to receive the profit and pay the loss on a daily basis. The profit (or loss) comes from the one-day appreciation (or depreciation) of the future price. Because of this the clearing house is on the hook for only the risk of one-day price movement. Moreover, investors are required to have a deposit as well on that account which likely covers the one-day loss. If there is not enough fund on the account, the clearing house require the investor to deposit additional funds (margin call). Finally, only an extremely volatile market can result in the loss for the clearing house. See Table 4 for a detailed comparison of futures and forward markets.

TABLE 4: COMPARISON OF FUTURES AND FORWARD MARKETS.

Futures	**Forward**
traded on organised exchanges	traded on OTC (Over The Counter) markets
standardized	non-standardized
low counterparty risk	high counterparty risk
regulated market	less regulated market
daily financial settlement	settlement at maturity
easy to close position	difficult to close position
cheap	expensive
highly liquid	rather illiquid
margin is required	margin is not required

Options *give their buyers the right* – but not the obligation – t*o buy/sell the underlying asset at a specified price in the future, while the option seller is obliged to accept the buyer's decision*.

The investor having the right is in long position, the other party having the obligation is in short position. In option markets, the procedure for shorting an option is commonly referred to as writing an option. The ***call option*** gives *the right to its owner to buy the underlying;* in the case of a ***put option*** *the investor in long position* (i.e. the buy of the option) *has the right to sell the underlying*. Therefore there are four possible positions depending on whether it is a call or put option and the investor is in long or short position

CALL option

- ***long call (LC)****: is the position of the option's buyer having the right to buy the underlying asset*
- ***short call (SC):*** *is the position of the option's seller (writer) having the obligation to sell the underlying asset, if the other contractor wants to buy it*

PUT option

- ***long put (LP)****: is the position of the option's buyer having the right to sell the underlying asset*
- ***short put (SP)****: is the position of the option's seller (writer) having the obligation to buy the underlying asset, if the other contractor wants to sell it*

At the time or in the period when the option expires, the value of the underlying determines whether the right to buy or sell will be exercised. Figures 5A and 5B show the values of the four positions.

FIGURE 5A: THE CALL OPTION.

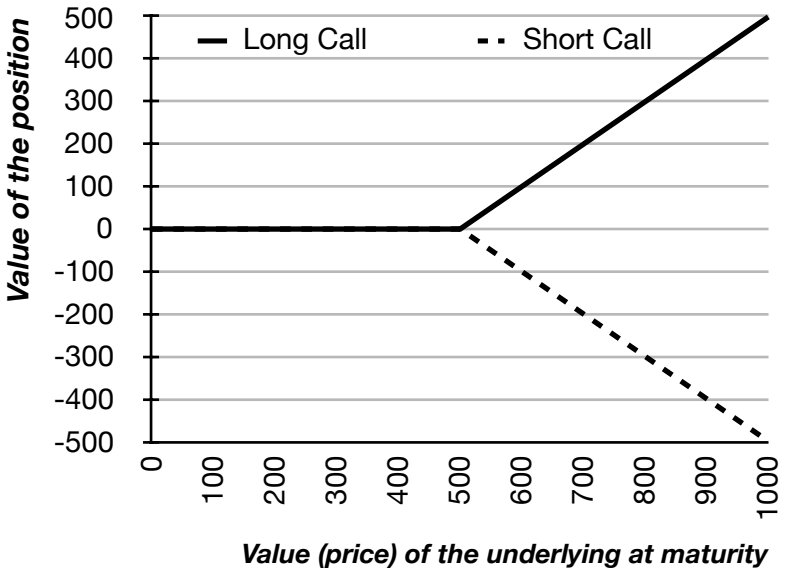
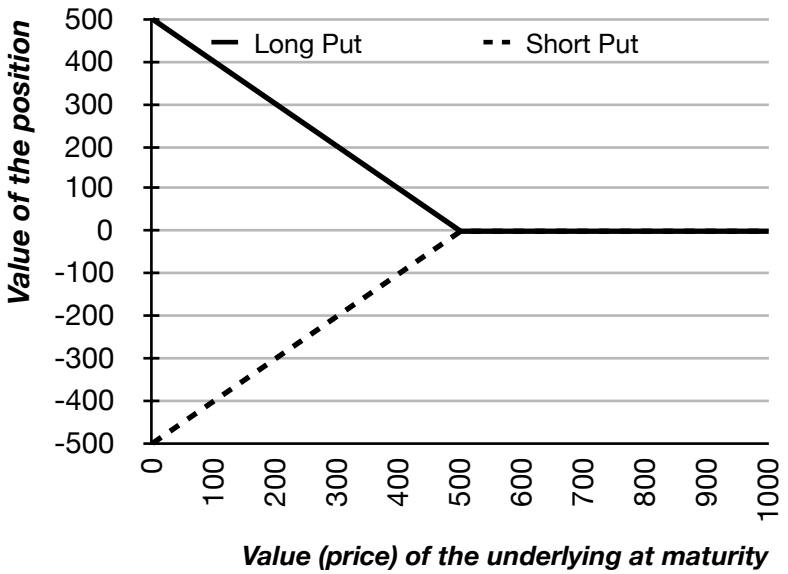


FIGURE 5B: THE PUT OPTION.



Based on the above, the investor in the long position seemingly can only win with the option (otherwise (s)he would not exercise his/her right), while the investor in short position can loose or make a profit of maximum zero. This is obviously known by both investors, therefore the counterparty in the short position will only enter into such contract if the other party pays for it (option fee).

There are many types of options, the most typical ones are the following. The American option can be exercised any time until its expiration date. The European option can be exercised only on the date of expiry. The Bermuda option can be exercised on the expiration date and on certain days before that. The value of an Asian option is based on the average price of the underlying asset, not on the prompt price of it at expiry. The barrier option can only be exercised if the price of the underlying asset is met or did not meet a predefined value. These options are preferred by the buyers of the options because these are cheaper than normal options due to the lower probability of payment. The binary option is practically a bet where the option pays a certain amount only if the condition in the contract is met (e.g. if there is a hurricane it pays 1000 dollars; if there is no hurricane it does not pay anything). Exotic options are complex structured products, where the value of the option is derived by many complicated factors. (Sebestyén 2016)

The third type of derivatives are the ***swaps***. They are about *exchanging future cash flows, out of which at least one is subject to uncertain factors* (such as interest rate, exchange rate, stock price or the price of goods). These deals are personalized, OTC agreements. The two most common forms are interest rate and exchange rate swaps. In case of the former one party pays fixed while the other pays floating interest rate on the same nominal value. To avoid excessive transaction costs and risks, the payments are netted, only the difference is paid.

> For example, the A firm pays 4% fixed interest to the B bank, while it pays EURIBOR +3,8% interest to the A firm under a swap contract with a face value of 15 million euros. The payments are fulfilled annually. If the EURIBOR for the actual payment is -0,18%, then the bank must pay the firm 543.000 euro. Since this amount is higher than the fixed interest (600.000 euro), after netting the payments the firm pays the bank 57.000 euro.

The reason behind an interest rate swap is usually that the buyer of the swap can have cheaper fixed / floating rate loan, while businesswise it would be more beneficial for it to have a floating / fixed rate. With an interest rate swap however, it can achieve both goals.

> For example, if the movements of interest rates are indifferent for the costs and incomes of a firm then the firm prefers to get fixed interest loan otherwise the increase of the interest rate increases its costs as well diminishing the profit while the incomes and the operating costs are the same. Getting a fixed rate loan, the movements of the interest does not affect its profit. In this case the firm gets a floating interest rate loan (if it's cheaper) of 50 million euros and looks for a bank who is willing to contract an interest rate swap for the face value of 50 million euro. By this position the firm pays the bank the fix interest, and the bank pays the floating interest the firm, which is equal to the interest of the loan.

In case of an exchange rate swaps, the interest rate, the duration and the face value are fixed, only the currencies are different. Thus, the parties pay each other the interest in different currencies in defined timing. Netting is not evident in this case as the currencies are different. The reason behind an exchange rate swap is usually that the buyer of the