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# Valuation of Certificates of Deposit[1]

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***Abstract:*** *Certificates of Deposit are securities that belong to the debt, short-term securities on the money market. It follows that for their valuations only yield method based on the present value of future income arising from and simple interest and discounting may be used. Approaches to valuing securities on the money market depend on the form of revenue – interest or discount. Interest-based are evidence of deposit, such as Certificates of Deposit, savings bonds; bringing the discount are treasury bills, commercial papers, and bills of exchange. In our paper we will focus on valuation of classic Certificates of Deposit from the point of view of their intrinsic value and income.*

***Key Words:*** *Certificate of Deposit; Intrinsic Value; Current Rate of Return; Principal; Accrued Interest Income; Income for Holding.*

## Introduction

Money market securities are short-term securities through which businesses can obtain short-term credit (commercial or bank credit) to invest temporarily free funds or they can serve as a means of payment.

Financial manager can get a credit only through certain kind of money market securities, for example through bills of exchange – commercial or financial credit. In the world, companies can get short-term credit through commercial papers. More options provides market with short-term securities for the portfolio investment of available funds of the company.[2]

Money market securities are characterised by a high degree of liquidity, low risk, smaller price fluctuations, but, compared to the capital mar-

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[2] See JÍLEK, J. *Finanční trhy*. 1. vyd. Praha: Grada, 1997. 527 p. ISBN 80-7169-453-3; and MUSÍLEK, P. *Trhy cenných papírů*. 2. aktualiz. a rozšíř. vyd. Praha: Ekopress, 2011. 520 p. ISBN 978-80-86929-70-5.

ket securities, they offer lower yield and under standard conditions do not increase the possibility of significant capital losses. One of the most widely used money market securities belongs to the Certificates of Deposit.[3]

In the terms of forms of yield, Certificates of Deposit belong to the group of securities that provide income in the form of interest, unlike treasury bills, commercial securities, and bills of exchange which provide a discount.[4]

Money market securities are debt securities and, therefore, can be valued using income method only. It means method based on the present value of future revenue these securities accrue. Since these are securities with a life of up to one year, simple interest and discounting are used in their valuation.[5]

## Certificates of Deposit

Certificates of Deposit are official documents of short-term deposits with a maturity up to one year, although in the current period of tremendously fast pace of innovation in financial markets we can encounter with various modifications also in the area of the Certificates of Deposit. In the presented paper we will focus on valuation of classic Certificates of Deposit, with a fixed interest rate, maturity, nominal (par) value at the end of life, and life up to one year.

## Certificates of Deposit valuation in terms of intrinsic value and yield

Investor can buy Certificates of Deposit on the primary money market or on the secondary money market. In case of the Certificate of Deposit purchase on the primary money market and held it to maturity, the investor will be interested in the *level of interest* and *future value of the Certificate*

[3] See BLAKE, D. *Analýza finančních trhů*. 1. vyd. Praha: Grada, 1995. 623 p. ISBN 80-7169-201-8; and HRVOĽOVÁ, B. et al. *Analýza finančných trhov*. 1. vyd. Praha: Wolters Kluwer, 2015. 512 p. ISBN 978-80-7478-948-9.

[4] See COPELAND, T., T. KOLLER and J. MURRIN. *Valuation: Measuring and Managing the Value of Companies*. 3rd ed. New York: J. Wiley, 2000. 494 p. ISBN 0-471-39748-2; and DAMODARAN, A. *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*. 1st ed. New York; Chichester; Brisbane; Toronto; Singapore: John Wiley & Sons, 1996. 519 p. ISBN 0-471-13393-0.

[5] See FABOZZI, F. J. *Bond Markets, Analysis and Strategies*. 3rd ed. Upper Saddle River, NJ: Prentice Hall, 1996. 595 p. ISBN 0-13-339151-5; and GERTLER, Ľ. Sovereign Spread and Its Measurement. In: P. JEDLIČKA, ed. *Hradec Economic Days 2014: Part IV*. 1st ed. Hradec Králové: Gaudeamus, 2014, pp. 149-155. ISBN 978-80-7435-369-7.

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*of Deposit*. The amount of interest and thus the future value of the Certificate of Deposit depend on the interest rate, maturity, and to some extent also on the standard used by the bank to determine maturity. Interest rates, regardless of the maturity of the Certificate of Deposit, are listed as the nominal interest rates, on an annual basis (per annum p.a.), assuming the receipt of interest once a year.[6]

## Calculation of interest and future value of the Certificate of Deposit at a fixed rate

Interest and future value of the Certificates of Deposit at a fixed rate can be calculated using the following formula, assuming the use of standard ACT/365 which banks generally prefer when calculating interest on deposit products (*in case of using other standard, formulas must be adapted to the given standard*):

$$Interest = NV.\frac{i}{365}.m_{im} \qquad (1)$$

Calculation of interest on the Certificate of Deposit using the simple interest.

In case of reinvestment in the same Certificate of Deposit within a year, the investor might be interested in the effective annual interest rate that can be calculated based on the following formula:

$$r_e = \left(1+\frac{i}{365}.m_{im}\right)^{\frac{365}{m_{im}}} - 1 \qquad (2)$$

Future value can be determined as the sum of the nominal (par) value of the Certificate of Deposit and interest:

$$FV = NV + Interest \qquad (3)$$

where:
NV – is the nominal (face) value of the Certificate of Deposit;
i – is the nominal interest rate of the Certificate of Deposit p.a. at the time of the issue;

[6] See PODMAJERSKÁ, K. Možnosti určenia nákladov podniku na získavanie a viazanie kapitálu. In: E. HYRÁNEK and L. NAGY, eds. *Aktuálne trendy a metódy vo finančnom riadení podnikov a ich vplyv na finančnú stabilitu podniku*. 1. vyd. Bratislava: Ekonóm, 2013, pp. 70-76. ISBN 978-80-225-3781-0; and *Národná banka Slovenska* [online]. 2017 [cit. 2017-06-07]. Available at: http://www.nbs.sk/.

$m_{im}$ – is the number of days from the issue to the maturity;
FV – is the future value of the Certificate of Deposit;
$r_e$ – is the effective interest rate;
365 / m – is an element which represents the annualisation of the interest rate.

## Calculation of current interest income and price of the Certificate of Deposit

Investors of the Certificates of Deposit on the foreign money markets have the opportunity to retain these short-term securities to the maturity or they can sell them on the secondary money market. The price of the Certificate of Deposit before the maturity on the secondary money market may not equal to the sum of the nominal (par) value and the corresponding part of the interest. It may be higher or lower, depending on the current market situation. Therefore, the rate of return of the Certificate of Deposit that investor purchases on the secondary money market (r) may not be equal to the interest rate determined at the issue (i).

Calculation of the current interest yield of the Certificate of Deposit which investor buys on the secondary money market sometime after issuing and which he/she retains to the maturity is presented by the following equation:

$$r = \left[ \frac{NV}{P.\left(1 + \frac{i}{365}.m_{im}\right)} - 1 \right] . \frac{365}{m_{sm}} \qquad (4)$$

where:
P – is the current market price on the secondary money market;
$m_{im}$ – is the number of days between the issue and the maturity;
$m_{sm}$ – is the number of days between the settlement and the maturity.

## Intrinsic value of the Certificate of Deposit

*Intrinsic value* (theoretical market price) of the Certificate of Deposit on the secondary money market is calculated as the present value of the future income (NV + interest) where in the role of the rate discount factor we use the current market rate of similar financial instrument (Certificate of Deposit) as follows:

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$$P = \frac{NV + NV.\frac{i}{365}.m_{im}}{\left(1+\frac{r}{365}.m_{sm}\right)} = \frac{NV.\left(1+\frac{i}{365}.m_{im}\right)}{\left(1+\frac{r}{365}.m_{sm}\right)} = \frac{FV}{\left(1+\frac{r}{365}.m_{sm}\right)} \qquad (5)$$

Actual (current) market price P can be divided into two parts – the accrued interest and the principal.

$$Accrued\ \ Interest = NV.\frac{i}{365}.m_{is} \qquad (6)$$

$$Principal = P - Accrued\ \ Interest \qquad (7)$$

where:
$m_{is}$ – is the number of days between the issue and the settlement.

## Calculation of yield for holding the Certificate of Deposit

If the investor buys a Certificate of Deposit on the secondary money market after its issue and sells it before the maturity, he/she will be interested in the rate of return for holding the Certificate of Deposit.

Calculation of the yield for holding the Certificate of Deposit can be performed using the following formula:

$$r_h = \left[\frac{\left(1+\frac{r_p}{365}.m_{pm}\right)}{\left(1+\frac{r_s}{365}.m_{sm}\right)} - 1\right].\frac{365}{m_{pm} - m_{sm}} \qquad (8)$$

where:
$r_h$ – is the rate of return for holding the Certificate of Deposit;
$r_p$ – is the rate of return of the Certificate of Deposit on the date of purchase;
$r_s$ – is the rate of return of the Certificate of Deposit at the date of sale;
$m_{pm}$ – is the number of days between the purchase and the maturity of the Certificate of Deposit;
$m_{sm}$ – is the number of days between the sale and the maturity of the Certificate of Deposit.

*If we assume a 270-day Certificate of Deposit issued at NV 100 000 EUR, with an interest rate of 2.30 % p.a., standard ACT/365, then*

*a) the amount of interest;*
*b) the future value;*
*c) the effective interest rate;*
*d) the current rate of return of the Certificate of Deposit held by an investor who bought it on the secondary money market at a time when there were 90 days remaining to the maturity or who will buy it at the market price of 101 000 EUR;*
*e) the yield during the holding, if an investor buys the Certificate of Deposit at the time when there are 210 days remaining to the maturity, with a yield of 2.60 %; later, when there are 90 days left to the maturity, the Certificate of Deposit is sold for yield 2.816 %,*

*are calculated according to the above-mentioned relationships as follows:*

*a) Interest = 100 000 . (0.023 / 365) . 270 = 1 701.37 EUR;*
*b) FV = 100 000 + 1 701.37 = 101 701.37 EUR;*
*c)* $r_e = [1 + (0.023 / 365) . 270]^{365/270} - 1 = 0.023\,07$, *i.e. 2.307 %;*
*d)* $r = [100\,000 / 101\,000 . (1 + (0.023 / 365) . 270) - 1] . 365 / 90 = 0.028\,16$, *i.e. 2.816 %;*
*e)* $$r_h = \left[\frac{\left(1+\frac{0.026\,0}{365}.210\right)}{\left(1+\frac{0.028\,16}{365}.90\right)}-1\right].\frac{365}{210-90} = 0.024\,2,\ i.e.\ 2.42\,\%.$$

Numerical values in task d) were chosen to show/display a significant difference between the interest rate at the time of the issue (2.30 %) – investment income from the Certificate of Deposit, if an investor bought it on the primary money market at the nominal (face) value of 100 000 EUR and kept it to the maturity, and yield which an investor achieved on the secondary money market (2.816 %), although he/she bought the Certificate of Deposit at a higher price of 101 000 EUR in the nominal (face) value (therefore, in our example the price of the Certificate of Deposit on the primary money market) and the investor will not hold it for 270 days, but only for 90 days which remain from the purchase of the Certificate of Deposit on the secondary money market until its maturity.

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What is the reason for the significantly higher rates of return to the investors on the secondary money market? The source of yield for the investors in securities not only on the capital market but also on the money market is not only the interest but also the price. It can be seen from the example that the significantly higher return to the investor on the secondary money market has been achieved because of smart buy.

The same yield as an investor who invests in a Certificate of Deposit and holds it for the entire life would be achieved if the secondary market price included a nominal (par) value plus accrued interest income for 180 days of holding the Certificate of Deposit by the original owner who sells the Certificate of Deposit – in our example as follows:

*100 000 + [100 000 . (0.023 / 365) . 180] = 100 000 + 1 134.27 = 101 134.27 EUR,*

*that is*

*r = [100 000 / 101 134.27 . (1 + (0.023 / 365) . 270) – 1] . 365 / 90 = approximately 0.023, i.e. 2.3 %.*

If an investor bought a Certificate of Deposit on the secondary money market for 101 000 EUR, he/she paid a net price (principal) amounting to only 101 000 EUR – 1 134.27 EUR = 99 865.73 EUR.

What other could be the reason for the theoretically lower Certificate of Deposit price (101 000 EUR) for the seller than the sum of the nominal (par) value and accrued interest which was earned for a holding period of the Certificate of Deposit from its purchase until its sale on the secondary money market (101 134.27 EUR)? This may be result of the excess of supply over demand, an urgent need for cash, but also a change of the current market interest rate of comparable financial instruments. For example, if the interest rate on the money market for the same Certificate of Deposit issued later rose from 2.30 % to 2.816 % (for example due to increase in the inflation rate) in which case the current market price was the same as in the example to calculate the current rate of return, that is:

$$P = \frac{100\,000.\left(1+\frac{0.023}{365}.270\right)}{\left(1+\frac{0.028\,16}{365}.90\right)} = \frac{101\,701.37}{\left(1+\frac{0.028\,16}{365}.90\right)} = 101\,000 EUR.$$

## Conclusions

In our paper we have focused on the valuation of one group of the money market securities – Certificates of Deposit, which are based on an interest.

Money market securities are characterised by a high degree of liquidity, low risk, and smaller price fluctuations. Compared to the capital market securities, they offer lower returns and under standard conditions also lower risk of significant capital losses.

Therefore, money market paper is valued only based on its intrinsic value and returns. Risk is being quantified to evaluate capital market debt securities (i.e. medium and long-term debts) and equity securities.

To estimate intrinsic value of the Certificates of Deposit that are short-term debt money market securities we can use only methods based on the present value of the future cash flow and the simple discounting.

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