Profitability and risk ratio of financial portfolio

Výnosnost a rizikovost finančního portfolia

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Abstract: Financial portfolio represents a certain type of investments diversification and hence it issues a possibility how to reduce risk ratio and to ensure a sufficient profitability of financial investment. The paper shows ways of calculation and evaluation of investment possibilities. A base for the determination of the efficiency of portfolio particular parts is a rate of efficiency of particular securities and their weight (representation) in the portfolio. Risk of an investment action is linked to the results of the technical analysis of particular securities and of the mutual dependence among them, resp. of their mutual ability to influence each other. The contribution is worked out on a theoretical basis, nevertheless, the procedure can be applied easily to the investment possibility in the area of securities. It cannot be used in enterprises of agricultural primary production but it can be applied in the dimension of the agri-food complex, respectively in the agri-business dimension.

Key words: financial investment, portfolio, profitability, risk ratio

Abstrakt: Finanční portfolio představuje určitý typ investorské diverzifikace a tedy možnost, jak omezit rizikovost a zajistit dostatečnou výnosnost finanční investice. Příspěvek nastiňuje možnosti výpočtu a vyhodnocení investičních možností. Při stanovení výnosnosti jednotlivých složek portfolia se vychází z míry efektivnosti jednotlivých cenných papírů a jejich váhy (zastoupení) v portfoliu. Rizikovost investiční akce je vázána na výsledky technické analýzy jednotlivých cenných papírů a vzájemnou závislost mezi nimi (resp. jejich ovlivnitelnost navzájem). Příspěvek je zpracován na teoretické bázi, postup je však snadno aplikovatelný na jakoukoliv investiční možnost v oblasti cenných papírů. Nelze ho použít v podnicích zemědělské prvovýroby (převažujícím typem vlastnictví nejsou a.s.), avšak je zcela aplikovatelný v dimenzi agrárně-potravinářského komplexu, respektive v dimenzi agrobyznysu.

Klíčová slova: finanční investice, portfolio, výnosnost, rizikovost

INTRODUCTION

Every investment and especially a financial investment is influenced by many factors. Among the most important of them, there belong the following three factors: profitability, risk ratio and time. An investor has to consider these three factors very carefully before he realises the investment. An ideal situation would be if the investment brings a high return without any risk. However, because this situation is illusory, investment possibilities should be chosen considering an "acceptability" of profitability and a "risk capacity" A basic and generally known rule is valid – do not focus only on one investment possibility, i.e. one security, but a financial investment should represent the so called financial portfolio, i.e. it should be composed by more securities. A financial portfolio is a certain type of investment diversification. It is a possibility to reduce the risk ratio and to secure sufficient profitability.

Following paragraphs aim at explaining the above mentioned principles of financial investment by a model example. This procedure could serve investors as a simple model of approach to selection or possibly to evaluation of investment possibilities.

MATERIAL AND METHODS

How to secure profitability of portfolio

Profitability on the general level means a rate of input capital use , i.e. a ratio between the obtained effect and costs which were expended on it. In the case of financial investment, profitability can be expressed as :

$$r_p = \frac{W_t - W_o}{W_o} \quad (1)$$

where

r_p = profitability of portfolio
W_t = aggregate price of securities in portfolio
W_o = aggregate purchase price of securities at time $t = 0$

From the relation (1), it is possible to derive an estimated value of portfolio at time *t*:

$$W_t = W_0 (1 + r_p) \quad (2)$$

At the stage of decision making about an investment, an investor should be aware of the fact that profitability

of securities which create the portfolio and also profitability of the portfolio are unknown variables in the future time periods. Nevertheless, we can estimate them based on basic methods of fundamental analysis. Most of these methods have a common instrument, capitalisation of incomes flowing from the ownership of securities. The procedure is based on evaluation of money flow, i.e. dividends which regard the time factor influence discounted by a discount rate. One of the possibilities to secure the estimated profitability of particular securities is the determination of the so called Interval Rate of Return (IRR). We stem from the following relations:

$$NVP = \left[\sum_{t=1}^{n} \frac{C_t}{(1+k)^t} \right] - P \tag{3}$$

where
NVP = net present value
C_t = estimated present flows at time t – dividends
k = discount rate
P = purchase price of security
t = time

If $NVP = 0$, we can express the sought value k', i.e., IRR (estimated profitability) of a security by the help of the relation:

$$O = \left[\sum_{t=1}^{n} \frac{C_t}{(1+k')^t} \right] - P \tag{4}$$

or equivalently

$$P = \left[\sum_{t=1}^{n} \frac{C_t}{(1+k')^t} \right] \tag{5}$$

It means that the estimated IRR of the given investment equals the discount rate by which the present value is equal to zero. This procedure can be applied either in the model of the so-called zero growth (it stems from the presumption of unchanging dividends) or for the model of constant growth (it stems from the presumption of constant change of dividends) or another model of constant growth (it considers growth of dividends after a certain time limit by which dividends develop individually).

Now we return to evaluation of portfolio profitability . In our demonstrative example, we have a portfolio composed by three securities A, B and C. We have to know their input data (see Table 1):
– the purchase price of one piece of security A, B, C (p_{oi})
– the number of securities in portfolio (n_{oi})
– estimated profitability of securities A, B, C (r_i)

1) By means of signposts in the Table 1, we are able to find out the profitability value of the portfolio from the mentioned relation (1),

$$r_p = \frac{W_t - W_o}{W_o} \quad \text{,where} \quad W_o = \sum_{i=1}^{n} W_{oi} \qquad W_t = \sum_{i=1}^{n} W_{ti}$$

The first step lies in the calculation of purchase price of securities setting up the portfolio according to the relation

$$W_{oi} = n_{oi} \times p_{oi} \tag{6}$$

Sum of values W_{oi} (= W_o) is the aggregate purchase price of securities at time $t = 0$. Next step is represented by the calculation of the estimated portfolio value. We use the estimated profitability and proceed according to the relation

$$W_t = W_{oi} \times (1 + r_i) \tag{7}$$

where r_i = profitability of security.

Sum of values W_{ti} is the required estimated portfolio value. By inserting it in the equation (1), we get the portfolio profitability.

The presented procedure is applied on the model example in the Table 2.

2) For the calculation of portfolio profitability, we can also use an alternative procedure where we use the share of particular securities in the total portfolio value at time of investment, i.e. at time $t = 0$ (application on the example is in Table 3).

At first, we set this share as the ratio of the value of particular securities in the total portfolio value at time

Table 1. Input data for calculations

Securities	Purchase price of 1 security (CZK)	Number of securities in portfolio	Estimated profitability
i	p_{oi}	n_{oi}	r_i
A	3 250	50	15.26
B	860	100	8.42
C	1 540	150	–1.24

Source: own calculations

Table 2. Calculation of portfolio profitability

Securities – i	Purchase price of securities in portfolio at time t_0 – W_{oi}	Market price of securities in portfolio at time t – W_{ti}
A	162 500	187 298
B	86 000	93 241
C	231 000	228 136
Σ	479 500	508 675

Source: own calculations

r_p = 0.006084; portfolio profitability is 6.08%.

Table 3. The alternative calculation of portfolio profitability

Securities – i	Share of a security value in portfolio value in time $t = 0$ (%) – x_i	Share of security in portfolio profitability (%)
A	33.8895	5.1715
B	17.9353	1.5105
C	48.1752	–0.5974
Σ	100.0000	6.0846

Source: own calculations

$t = 0$. Further we find out, by the means of product of the ratio and the estimated profitability, the contribution of particular securities to the profitability of portfolio. Sum of the values of this contribution represents also the portfolio profitability.

Also using the alternative way of calculation, we got the value of portfolio profitability 6.08%.

From the above mentioned, a conclusion results for every investor. Portfolio profitability depends not only on the profitability of particular securities but also on their share in the portfolio value.

HOW TO SET THE RISK RATE OF PORTFOLIO

An investor has to look at profitability as a "random quantity" (from the statistical point of view). A random quantity is characterised by the so called moments. One of these is the standard deviation which helps to estimate the range of deviation of the real result from the estimated one, hence, in case of financial investment, the deviation of real profitability from the estimated.

In its calculation we proceed as follows:

$$\sigma_p = \left[\sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \sigma_{ij} \right]^{1/2} \quad (8)$$

where

σ_p = risk ratio of security portfolio

X_i, X_j = weight of security in portfolio, i.e. share of i^{th} (resp. j^{th}) security in portfolio value at time t_0

σ_{ij} = covariance of profitability between i^{th} security and j^{th} security

Covariance expressing dependence between the chosen securities can be determined according to the relation:

$$\sigma_{ij} = \zeta_{ij} \times \sigma_i \times \sigma_j \quad (9)$$

where

σ_i, σ_j = standard deviation of profitability in i^{th} (j^{th}) security

ζ_{ij} = correlation coefficient for dependence of profitability between i^{th} and j^{th} security

Securities in a portfolio can correlate in various ways. Some securities can correlate positively, other negatively and some can behave indifferently. The value and the sign (+ or –) of the correlation coefficient is of a great importance in setting the portfolio regarding risk. The correlation value signalises a strong or weak linkage between securities. The more the value of correlation coefficient is close to 1, the stronger the dependence is. Positive or negative values define the nature of dependence. With positive correlation between two securities, profitability of the second security changes with the change of profitability of the first security. With a negative correlation, the change of one security invokes an opposite change of the second security. Indifferent securities have productivities completely independent on each other.

When calculating the final value expressing the risk ratio of a portfolio in the model example, we use a matrix in the calculation of relation (8). We will get a standard value in the following form:

a) with use of the covariance

$$\begin{aligned}\sigma_p = [& X_1 X_1 \sigma_{11} + X_1 X_2 \sigma_{12} + X_1 X_3 \sigma_{13} + \\ & X_2 X_1 \sigma_{21} + X_2 X_2 \sigma_{22} + X_2 X_3 \sigma_{23} + \\ & X_3 X_1 \sigma_{31} + X_3 X_2 \sigma_{32} + X_3 X_3 \sigma_{33}]^{1/2}\end{aligned} \quad (10)$$

b) or by analogy by means of the correlation coefficient

$$\begin{aligned}\sigma_p = [& X_1 X_1 \sigma_1 \sigma_1 \zeta_{11} + X_1 X_2 \sigma_1 \sigma_2 \zeta_{12} + \\ & X_1 X_3 \sigma_1 \sigma_3 \zeta_{13} + X_2 X_1 \sigma_2 \sigma_1 \zeta_{21} + \\ & X_2 X_2 \sigma_2 \sigma_2 \zeta_{22} + X_2 X_3 \sigma_2 \sigma_3 \zeta_{23} + \\ & X_3 X_1 \sigma_3 \sigma_1 \zeta_{31} + X_3 X_2 \sigma_3 \sigma_2 \zeta_{32} + \\ & X_3 X_3 \sigma_3 \sigma_3 \zeta_{33}]^{1/2}\end{aligned} \quad (11)$$

Since the diagonal elements of the correlation matrix equal one, and $\zeta_{ij} = \zeta_{ji}$, it is possible to choose a simpler version:

$$\begin{aligned}\sigma_p = [& X_1^2 \sigma_1^2 + 2 X_1 X_2 \sigma_1 \sigma_2 \zeta_{12} + 2 X_1 X_3 \sigma_1 \sigma_3 \zeta_{13} \\ & + 2 X_2 X_3 \sigma_2 \sigma_3 \zeta_{23} + X_2^2 \sigma_2^2 + X_3^2 \sigma_3^2]^{1/2}\end{aligned} \quad (12)$$

Applying these relations on the above mentioned model example, we obtain the following results:

The calculated portfolio profitability is 6.0846% and the share of security value in the portfolio value is X_i:

Table 4. Weight of security in portfolio

Security	Weight of security in portfolio X_i (%)
A	33.8895
B	17.9353
C	48.1752
	100.0000

Source: own calculations

The covariance and correlation matrices were calculated further for the profitability of securities. Profitability of securities A correlates positively with profitability of securities B ($\zeta_{AB} = 0.547$) and negatively with profitability of securities C ($\zeta_{AC} = -0.827$). Profitability of securities B correlates negatively with profitability of securities C ($\zeta_{BC} = -0.588$).

By means of standard deviations of profitability of the securities A, B, C and calculated correlation coefficients, the co-variation matrix was composed (Table 5).

Now by means of the relations shown (10), we calculate the standard deviation σ_p which represents the risk ratio in the portfolio:

$$\sigma_p^2 = 0.33885^2 \times 0.31458 + 2 \times 0.338895 \times 0.179353 \times 0.15713 + 2 \times 0.338895 \times 0.481752 \times (-0.89351) + 2 \times 0.179353 \times 0.481752 \times (-0.57958) + 0.179353^2 \times 0.26187 + 0.481752^2 \times 3.71061 = 0.5328$$

$$\sigma_p = \sqrt{0.5328} = 0.7299 = 0.73$$

Profitability of the portfolio then is within the interval: (profitability – risk ratio, profitability + risk ratio), hence (6.08 – 0.73, 6.08 + 0.73), i.e. 5.35 – 6.81%.

Table 5. Co-variation matrix

	A (1)	B (2)	C (3)
A (1)	0.31458	0.15713	–0.89351
B (2)	0.15713	0.26187	–0.57958
C (3)	–0.89351	–0.57958	3.71061

Source: own calculations

CONCLUSION

This result should show to an investor that though the estimated profitability of portfolio should reach 6.08% according to the calculation, then regarding the risk ratio in the positive case it could reach even 6.81%, and in the negative case, the estimated value of profitability could fall to 5.35%.

The article deals with possibilities of efficiency evaluation of investment into securities. In the agricultural primary production, where a completely different legal type of ownership predominates (co-operatives, private farmers), there are business companies including the joint-stock ones, however, at present (and in the nearest future) it is just hardly possible to imagine an investment into this enterprise branch. A completely different situation is in the agribusiness dimension or in an agri-food complex where joint-stock companies present a frequent type of ownership and investment into some of them could be a profitable business, considering all aspects.

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