

UTILIZATION OF QUANTITATIVE METHODS IN THE DECISION MAKING PROCESS OF A MANAGER

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Abstract: *For economic phenomena and their quantification there is a range of models that produce varying results depending on their formulation. In relation to investment decision making various models for calculation of the intrinsic value per share and their differing results are demonstrated. In order to use individual models, market value forming factors, which are the basis of these models, are defined as well as assumptions for their validity.*

Keywords: *Quantitative Methods, Manager, Intrinsic Value Per Share, Models, Decision Making*

1. Introduction

A fundamental activity of the manager in the process of management is decision making. The manager makes decisions intuitively according to their knowledge, experience and practice, frequently according to their concepts or moods. In respect of significant decision-making tasks it is advisable to utilize exact decision making based on formalized economic models using mathematical tools, statistics, optimizing methods etc.

As far as exact decision making is concerned quantitative methods are available which can be used to a sufficient degree for individual types of tasks. Quantitative methods are based on models whose objective is to formalize and reflect a given practical problem as faithfully as possible. This approach to decision making is considered scientific and is valid for almost all economic phenomena. Nonetheless, every economic model is based on a certain level of abstraction that is generally accepted by experts. Thus scientific theory as model-based explication of economic processes has become an inseparable part of given reality.[5]

Models and their application produce very precise outputs, calculated parameters and values. Use of these outputs in decision making need not always necessarily lead to good results. This is because every model – qualitative method and formula for calculation of economic quantities is based on certain assumptions. Reliable results are achieved when such assumptions are fulfilled in economic reality. The correspondence between assumptions and reality is very rare in practice. The reason for this is the fact that economic systems and phenomena are not entirely predictable since the development of socio-economic systems and phenomena is not linear. Economic models are, as a rule, accepted due to their higher or lower plausibility in regard to their suitability which is again underlain with the belief that they correspond to certain notions about economic reality. Economic models gradually replace one system with another according to the understanding of decisive factors of the development of economic reality.[5]

The main aspect influencing selection or acceptance of a concrete model is the choice of the manager or economist. Therefore selection of an economic model is

based on professional competence, knowledge and preferences of every individual. The manager picks such model that corresponds best to their idea of correctness of assumptions of a given model and expected results. This is true especially when there are more mathematical models available for calculation of a single economic quantity or phenomenon.

In the following text results of various models used for investment decision making are compared. The objective is to assign factors to individual models on which the models are based and determine assumptions for their validity. The definition of factors and assumptions of validity for examined models makes it possible to evaluate all possible solutions in the final decision making of the manager.

2. Decision making concerning investments into securities

Utilization of exact methods of decision making based on mathematical models can be demonstrated on the sphere of financial resources allocation. As an example decision making in the course of investing into securities, or into shares, to be more specific, can be looked into. Managers in the role of investors can face this problem when aiming to increase the value of free financial resources of their company on the capital market or when considering a purchase of a controlling amount of shares in order to take over management over a concrete joint-stock company, which may often be their competition. A key question for correct investment decisions is correct evaluation of the share value, that is, establishing the intrinsic value per share.

The intrinsic value per share reflects the real value of a given joint-stock company resulting from the economic situation, financial health and prospects of further growth. The intrinsic value per share deviates from the market price, which is a result of anonymous supply and demand on a regulated market, that is, on the securities stock exchange. An investment decision concerning purchase of shares is then based on comparison of the intrinsic value to the spot market value.[6]

When evaluating shares according to their intrinsic value there is a whole range of models used to calculate the intrinsic value. Nonetheless, these models are based on various market value forming factors that influence the market value and its shifting.

Economic theory at the moment gives 15 models for calculation of intrinsic value per share, and each of them is based on different factors and their validity is based on fulfilment of concrete assumptions. The most important models are:[3]

- ⇒ Dividend Discount Model – based on discounting predicted dividends back to present value,
- ⇒ Profit Model – based on the standard value of P/E ratio (spot market value to net profit per share) and predicted profit,
- ⇒ Combined Profit and Dividend Model – based on the combination of the both preceding models,
- ⇒ Free Cash Flow Model – based on discounting cash flows and the effect of tax shield,

- ⇒ Balance Sheet Model – five versions (nominal, book, substance, reproduction, liquidation) based on various evaluations of the property of a joint-stock company,
- ⇒ Substitution Model – based on substituting the evaluated joint-stock company with similar companies,
- ⇒ Historical Models – four basic versions (incomes, book value, dividends and cash flow) based on historical development of the market value per share and the given economic quantity.

In Table 1 market value forming factors are assigned to the models and assumptions of their validity are determined.

Tab. 1: Models for calculation of intrinsic value per share

Model	Factors	Assumptions
Dividend Discount Model	Payment of dividends	Continual growth of dividends
Profit Model	Net profit	Accomplishment of profit, determining the correct P/E ratio value (ratio of market value to net profit per share)
Combined Model	Dividends, Profit	Growth of dividends, Accomplishment of profit, Correct P/E ratio value
Free Cash Flow Model	Cash flows	Increase in cash flows and utilization of tax shield
Balance Sheet Model	Value of the property	Correct evaluation of items in assets and liabilities
Substitution Model	Net profit, market value	Identity of economic parameters of substituted joint-stock companies
Historical Model	Incomes, Book value of property, Dividends, Cash-flow	Identification of mean historical values

Source: prepared by authors themselves

When evaluating a share it is the preferences of the manager that make him/her to pick a certain model to calculate the intrinsic value. It is a fact that every model produces different concrete results and thus leads to different investment decisions, i.e. whether to buy the share for a given market value or not. A wrong decision of the manager based on an unsuitably selected model has significant financial impacts, which tend to be negative.

An illustration of this can be evaluation of the shares of Pražská energetika a. s. company that were marketed at the Prague Stock Exchange. Table 2 shows the sums of the intrinsic value per share calculated current to a single date using various models.

The chosen example manifests that the used models determining precisely the intrinsic value per share on the basis of mathematical formulas produce extremely different results. The lowest value of 194.41 CZK has been calculated using the historic model of cash flows and the highest value of 2 829.21 CZK has been obtained through the profit model. The arithmetic mean of the shown thirteen evaluations is 1 491.08 CZK. The deviation of the highest value from the mean is 189.7%. The spot (current) market value of the share of Pražské energetiky a. s. at the Prague Stock Exchange for the date of calculation was 1 895 CZK. Thus ten models showed that the share was undervalued on the market with the conclusion that it can be bought as cheap while three models showed that the share was overvalued with the conclusion that it should not be bought since it was expensive.

Tab. 2 –Intrinsic Value per Share for the shares of Pražská energetika company in CZK

Model	Intrinsic Value
Historical model of CF (cash flow)	194.41
Balance sheet model – nominal value	1 000.00
Free cash-flow model	1 002.79
Substitution model	1 199.75
Balance sheet model – liquidation value	1 229.77
Dividend discount model	1 277.75
Balance sheet model – reproduction value	1 292.27
Historical model of BV – book value	1 673.36
Historical model of D (dividends)	1 725.64
Balance sheet model – BV (book value)	1 795.83
Combined dividend and profit model	2 020.63
Historical model of S (receipts or sales)	2 142.59
Profit model	2 829.21

Source: [4]

Great differences between the calculations of intrinsic value have also been confirmed in the evaluation of shares of Philip Morris company. Calculated values according to various models are shown in Table 3.

Tab. 3: Intrinsic Value per Share for the shares of Philips Morris ČR in CZK

Model	Intrinsic Value
Historical model of BV – book value	4 053.07
Historical model of D (dividends)	10 378.77
Historical model of S (receipts or sales)	10 586.38
Profit model (normal P/E ratio)	11 135.25
Dividend discount model	16 644.00

Source: [2]

The dispersion of the values from the lowest to the highest value is quadruple. Current to the date of evaluation the spot market value of the share at the Prague Stock Exchange was 17 240 CZK, thus all models indicated overvaluation. If the spot market value of the share dropped, which is quite common on capital markets due to significant volatility of current market values of shares (the market value of the share of Philip Morris ČR has varied between 3 745 CZK up to 19 540 CZK during the recent five years), the models would generate opposing investment recommendations.

Another pitfall for the use of the models for calculation of the intrinsic value per share lies in the setting of correct parameters that every model is based on. Thus, based on used parameters, we can arrive at different values even when using a single model for the calculation. For example in the profit model, in which the intrinsic value is the product of multiplication of the normal P/E ratio value by the predicted profit per share next year, the result depends on the correct determination of the normal (standard) value of the P/E ratio. Table 4 shows methods to determine the P/E ratio, identified values of the P/E ratio and the intrinsic value per share calculated while using the same predicted net profit per share. The data relate to Telefónica O2, a.s joint-stock company.

Tab. 4: Determining of the normal value of P/E ratio and the values of the intrinsic value per share for shares of Telefónica O2.

Method of determining the P/E ratio	Value of the P/E ratio	Values of the intrinsic value /CZK/
Industry value of the sector of tobacco companies incorporated in S&P 500 stock exchange index	7.23	236.64
Calculation according to the Gordon model	5.96	194.6
Calculation using a regression formula	11.15	364.80

Source: [1]

Again, the calculated sums for the intrinsic value show a significant dispersion in relation to the used P/E ratio value.

The model for calculation of the intrinsic value per share, although we consider it to be correct from the viewpoint of acceptance of the market value forming factor, is based on certain assumptions which, nonetheless, need not be fulfilled in reality. For example discount dividend models are based on the assumption that dividends will grow continuously, which may not be achieved in future. Joint-stock companies which have paid increasing dividends for years can lower the dividends in future or stop the payment whatsoever, as has Česká spořitelna joint-stock company done, which paid a dividend of 120 CZK per share in 2009, but only 30 CZK in 2010, which represents a drop of 75%. Almost each and every joint-stock company in the Czech Republic, as well as in the world, has recently decreased the dividends due to the current effect of the economic crisis.

6. Conclusion

Quantitative methods used in economics are an important tool for decision making of managers. For some economic phenomena there are more models, which define these phenomena and quantify them. This is attributable to the complexity and ambiguity of economic relations resulting from attitudes, motives and actions of economic subjects. By using individual models a whole range of differing results can be obtained for an analysed phenomenon. This has been manifested by the example of calculation of the intrinsic value per share as a basis for investment decisions.

When a manager or investor makes a decision concerning purchase of shares it is entirely up to this person which model for calculation they choose since they are convinced that the given model is the right one. What matters then is the preference for a market value forming factor on the basis of which a given evaluation model is formulated. The risk of selecting a wrong model in the course of investment decision making can be reduced by using a mean value of the calculated results for the intrinsic value per share. The mean value reflects the effects of other market value forming factors incorporated into individual models. A more accurate result is achieved through

a weighted mean, in which weights assigned to given models are defined by the manager according to his or her preferences for individual factors. The same approach can be used in the case of different values produced by a single model as a consequence of using different parameters, e.g. P/E ratio.

Despite differences and, at times, opposing results obtained through quantitative methods the use of these methods in the decision making process of managers is justified. They make it possible to assess a given economic phenomenon from various points of view and through various attitudes (influencing factors) and analyse the phenomenon in its complexity in this way. The range of obtained results delimits an interval within which the estimated economic phenomenon or quantity may vary. Thus managers gain good exact foundations for their decision making. The example of calculation of the intrinsic value per share shows the scope of models producing different results and a possible way of their utilization, e.g. by applying a weighted mean of obtained values. Therefore the use of quantitative methods in the managerial decision making is justified.

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