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FINANCIAL MATHEMATICS AS A TOOL FOR BUSINESS VALUATION

Modern mathematics is a universal set of applied knowledge that is increasingly integrated into various sciences, including economics. Economics, as a science that studies the objective causes of society's development, requires quantitative and qualitative assessment of development. Such an assessment can only be provided through the lens of a large number of mathematical methods and models.

Financial Mathematics is a special area of probability and mathematical statistics focusing on mathematical models of financial (and other) markets and in general on mathematical areas relevant for the financial (and insurance) industry. Financial mathematics is also heavily linked to analysis, numerical mathematics and optimization. Needless to say that it is also heavily related to economics and business studies, as the mathematical modelling of economic markets and agents needs considerable insight into them. Today, economic science places the mathematical model at the forefront as an effective tool for research and forecasting of the development of economic processes and phenomena. Mathematics has also become an integral part of the study of processes and phenomena in the financial sphere, where relations arise regarding the effective formation and rational use of financial resources and the creation of funds of money to ensure the social and economic development of society. Finance always has a monetary form of expression, namely money most often changes its value under the influence of certain factors. Quantitative analysis of the reasons for changing the value of money is based on the use of mathematical tools.

Current market conditions require business entities to be able to anticipate the financial implications of any commercial transaction and to use financial and economic analysis in practice. The mathematical apparatus of financial and economic analysis consists of methods and models of financial mathematics, which allow to describe at quantitative and qualitative levels phenomena and processes of financial sphere. The tools of financial mathematics were also used in the process of assessing the cost of business of individual economic entities. A wide range of users of information of the results of such

assessment and its analysis (creditors, investors, owners) updates the development of practical achievements in the field of application of financial mathematics instruments in business valuation.

Knowing the time and cost of buying and selling a certain asset, you can always determine the profitability of this market transaction and vice versa. Thus, the financial calculations for this commercial transaction include estimates of the value, time, return, and even reliability of the transaction. [1, p. 334]. The business/enterprise value is determined through estimates of real and potential income expressed in monetary terms as of the date specified.

Recent years have seen a plethora of new management approaches for improving organizational performance: total quality management, flat organizations, empowerment, continuous improvement, reengineering, kaizen, team building, and so on. Many have succeeded – but quite a few have failed. Often the cause of failure was performance targets that were unclear or not properly aligned with the ultimate goal of creating value. Value-based management (VBM) tackles this problem head on. It provides a precise and unambiguous metric-value-upon which an entire organization can be built. When VBM is working well, an organization's management processes provide decision makers at all levels with the right information and incentives to make value-creating decisions. Take the manager of a business unit. VBM would provide him with the information to quantify and compare the value of alternative strategies and the incentive to choose the value-maximizing strategy.

The thinking behind VBM is simple. The value of a company is determined by its discounted future cash flows. Value is created only when companies invest capital at returns that exceed the cost of that capital. VBM extends these concepts by focusing on how companies use them to make both major strategic and everyday operating decisions. Properly executed, it is an approach to management that aligns a company's overall aspirations, analytical techniques, and management processes to focus management decision making on the key drivers of value.

Such an estimate is based on a cash discount process that is conceptual in a financial computing apparatus. This is a method of reducing the future value of cash to its value in the current period. Objectively, for the owner, quantitative assessment of the

value of a business in the current period of time is more informative and useful than its value in the future. The inexpedience of determining the future value of an enterprise is also due to the uncertainty of final period of its existence. In the strategic plan, the owner always provides the prospect of long-term business functioning.

Thus, one more tool of financial mathematics which is used at business valuation is calculation of the current value of perpetual annuities (annuity – the elements of a cash flow arriving with identical frequency). We will present formulas of calculation of each of the indicators in formalized form. Capitalization rate – this is an indicator that is used to convert future incomes from a valuation object to its present value [2, p. 81]. General formula for value determination of the valuation object:

$$V = \frac{\text{average net operating income}}{\text{capitalization rate}}. \quad (1)$$

Formula for determining the value of a perpetual annuity:

$$PV = \frac{A}{r}, \quad (2)$$

where PV – current value of annuity; A – Constant annuity(rent payments, dividends per share, average income/earnings, etc.); r – interest rate for the period (bank rate, capitalization rate, weighed average capital cost, rate of return on investments).

The formulas for calculating the cost of the evaluation object and the value of the perpetual annuity are not only similar to each other, but carry the same content: value determination of future (projected), the same in the amount of cash proceeds normalized to current time period.

Several methods can be used to justify the capitalization rate for business valuation. Some of these are the Invud, Ring and Hoskold methods. These are ways to recover invested capital not only for profit, but also for full recovery. Under such conditions, the capitalization factor consists of two parts, namely 1) the rate of return on invested capital - the reward of the owner of capital for the value of money, taking into account the time factor and a number of other business-related factors. In other words, it is the percentage that the owner of capital wants to earn, the profitability of his activities; 2) rates of return (refund) on invested capital, which are determined by the value of annual loss of capital during the forecast period of use, the nature of changes in the value

of net income and the method of reinvestment of received income. Invud's annuity model, which reflects the realities of the modern market, has become most common. The model assumes even reimbursement of capital and is fair under some assumptions: the forecast end life of the investment object is set; the object generates a constant net operating income (NOI) throughout its lifetime (forecast period); annual payments generated by net operating income are received at the beginning of each year (advance payments); part of the periodic income, which is the return of capital, is reinvested at the rate of income per invested capital; after the end of the life (forecast period), the object loses its value completely, that is, the future value of FV = 0, that is, it is impossible to obtain additional income from the sale of the object [3, p. 16].

Under this model, the amount of return of capital is reinvested at the rate of return on invested capital. In this case, the recovery rate as part of the capitalization factor is equal to the sinking fund factor at the same interest rate as the rate of return on invested capital. From the point of view of financial mathematics, the sinking fund factor of invested capital is nothing but the inverse value to the value of the multiplier for the annuity FM3 (r; n).The economic content of the multiplier is that it shows what is the sum of the urgent constant annuity of one monetary unit by the end of its validity. The sinking fund factor shows the amount of money that must be deposited at the end of each period in order to accumulate 100% of the invested capital after a specified number of periods. Thus, financial mathematics is a significant tool in business valuation and it is only a small part of mathematical methods and models that allow qualitative analysis and quantification of the cost of capital and enable its owner to be more flexible in business management.

References

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