Chapter 7
The Application of Proof and Simultaneous Equations in Valuation:
The Valuation of Shares When a Firm Acquires Shares in Other Firms or From Its Own Shareholders

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ABSTRACT

The purpose of this chapter is to demonstrate how the notion of "proof" can be used to resolve issues of valuation in finance and how the method of simultaneous equations can be applied to determine the value of shares in two firms that hold an investment of shares in one another at the same time. The reader will be introduced to the notion of proof by arbitrage as it is was first pioneered in modern finance by Modigliani and Miller and then its application in providing guidance to practitioners of valuation will be explored.

INTRODUCTION

Valuation is a branch of finance concerned with the estimation of an asset's value. In particular, it is the intrinsic value of an asset defined as the value of an asset given a hypothetically complete understanding of the asset's investment characteristics that is of interest. Although models that are used in valuation are quantitative, valuation can be thought of as both an art and a science since inputs are often the result of subjective judgements. As a result, for "any particular investor, an estimate of the intrinsic value reflects his or her view of the "true" or "real" value of an asset" (Pinto, Henry, Robinson, & Stowe, 2010, p. 2). A basic challenge for the investor is therefore to reduce the level of subjectivity involved and replace it with an objective rigour that assists in making financial decisions. This chapter is concerned with how

mathematical reasoning can help reduce the level of subjectivity in valuation by providing a framework in which to analyse a problem and offer direction in which to solve it. In particular the role of proof in finance will be examined and how it can be utilised to resolve issues in valuation.

This chapter will begin with an introduction to the method of 'arbitrage' as a formal proof to propositions in finance and then explore its application for the purpose of establishing the equity value of a firm in instances where it acquires shares in another firm or from its own shareholders. Before examining the case in which two or more firms hold shares in each other at the same time the more common situation in which a firm acquires shares in another firm as a form of investment will be explored. Finally, the outcome of a share repurchase will be investigated and concluding remarks will be discussed.

BACKGROUND

"A postulate of sound investing is that an investor does not pay more than for an asset than it's worth" (Damodaran, 2002, p.1). The price paid should reflect the future cash flows that are expected to be generated from holding the asset. The source of these cash flows are the expected earnings stream that is generated from the operating assets employed by the firm for which the asset has a claim over and, as such when appraising the price, investors should consider these along with the obligations that a firm has to other security holders. A sound methodology in which to evaluate a firm and its securities is therefore required and a wide array of models and techniques are used in practice.

These range from the simple to the complex and each relies on a range of assumptions which lead to outcomes that may vary significantly. For example, the discounted cash flow model relies on estimates of expected future cash flows that are then discounted to a present value. A simple approach to model cash flows is to assume the current level of cash flows will occur in perpetuity, whereas a more complex approach will entail a detailed analyst in which individual items of cash flow together with their sources are considered and then aggregated on an annual basis. In other approaches, such as relative valuation models, estimates of future performance are not required and a value is determined from observation of the price of a comparable asset and its relationship with an accounting variable, such as earnings per share.

As such, the choice of model type and the underlying assumptions will determine the outcome and employing more than one model will lead to a disparity in values. Wishing to avoid paying a price for a security that is more than it is worth, practitioners may adopt techniques that minimise this variation and to provide a verification that the outcome is reasonable.

One approach is to employ a number of these methodologies to be used to act as a cross-check but ultimately the determination of value is a matter of judgement. A framework which enables the user to reconcile the outcome of one method against another and provide a justification for implementing a preferred method or set of assumptions is more useful to investors than comparing the outcomes from a set of disparate assumptions or models. As such this chapter is interested in how mathematics assists in this endeavour.

THE NOTION OF PROOF IN FINANCE

Proof is used by mathematicians to determine which statements of mathematics are true. In finance, proof of whether a firm's financing decisions can affect its market value can be established by way of

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