Theory of Financial Structure

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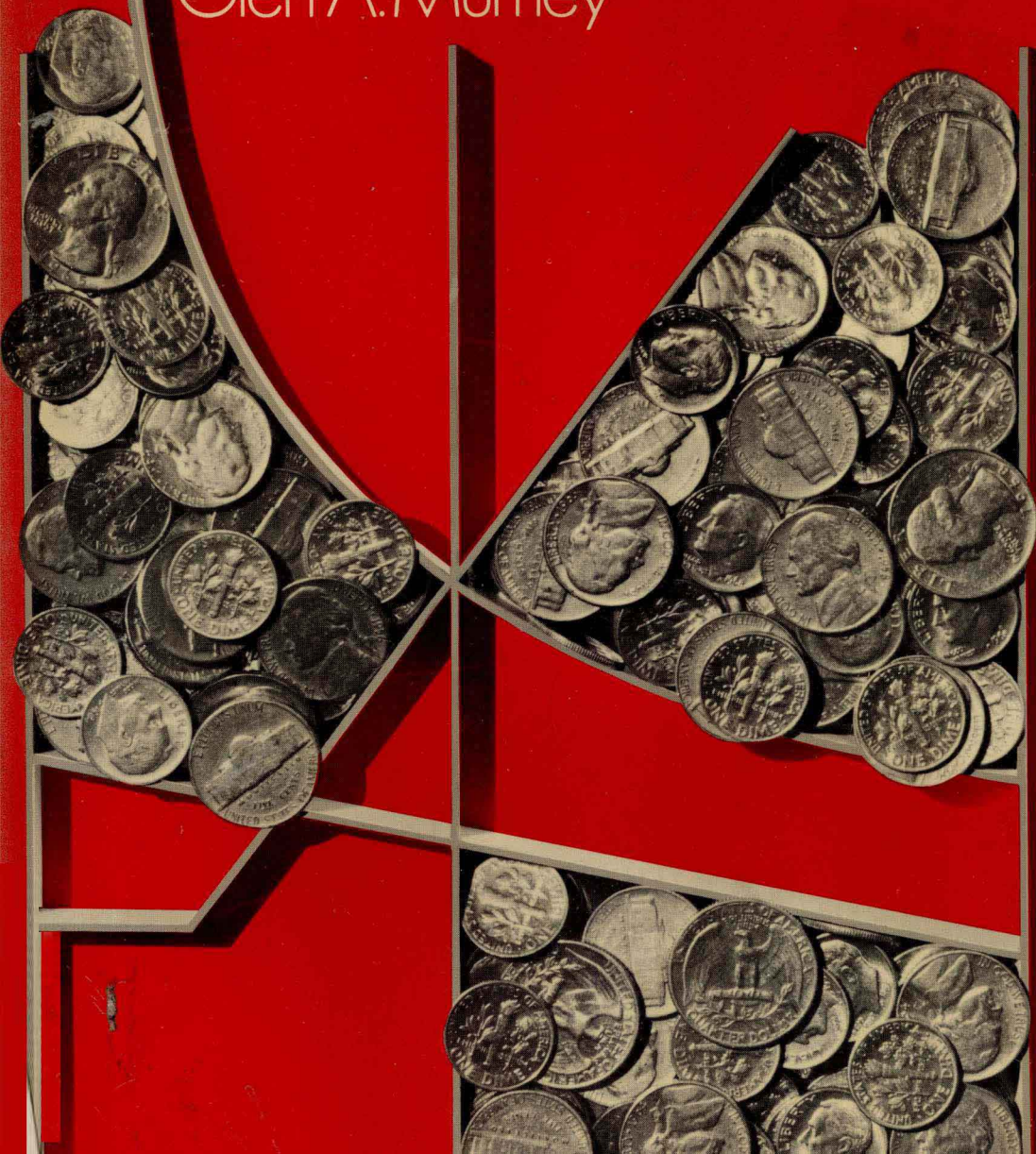

THEORY OF FINANCIAL STRUCTURE

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To my parents, Mr. and Mrs. Leo Mumey.

PREFACE

Even advanced textbooks in the area of business finance have usually divided their efforts between investment decisions and financing decisions. I have attempted in this text to concentrate on an intensive treatment of financing decisions. While the preponderance of the literature on this subject is developed in the area of corporation finance, I have expanded my theoretical development to include the financing of unincorporated businesses and of public investment projects. I have also attempted to focus the student's attention on risk, particularly as a quantifiable phenomenon, by adopting an elementary measure of risk and exploring the logical consequences of this on financial decisions. Finally, I have tried to emphasize that the theoretical aspects of finance comprise a subset of microeconomic theory.

The text is intentionally free from complex mathematical expressions. The development of rigorous mathematical analysis would have two disadvantages: First, it would deter many readers who might otherwise advantageously obtain some understanding of the theoretical developments in this area; secondly, a classroom textbook should stimulate the student toward the development of simple models of his own rather than present him with equation systems in fait accompli condition.

The work is almost entirely nonempirical in nature. There are large gaps in the existing empirical development, particularly in the area of risk; I felt that a survey of empirical material and a discussion of its limitations would constitute a topic separate from the book's intended purpose.

Pedagogically, the book is an attempt to find a middle ground between complication and simplification. I have tried to avoid understating the complexity of attaining optimal financial solution and, at the same time, to hold the reader's interest by abstracting away many details. Finally, I have tried, by means of many arithmetic examples, to involve the reader at a level other than generalization. My own students, unless they are required to grapple with the arithmetic implications, tend to overestimate their degree of understanding of general principles.

My material is at a level that should be suited for third- or fourth-year

undergraduate students in business or economics, and for beginning post-graduate students in these areas. The reader should have been exposed to elementary economics, and preferably to a course in intermediate microeconomic theory. Additionally, he needs a very limited knowledge of basic accounting notation and some familiarity with elementary mathematics of finance. Some acquaintance with probability theory and a basic course in business finance or public finance would be useful, but probably is not essential.

I wish to express deep appreciation to my wife, Lois, for her many useful comments on the first draft of this book and for her constant help thereafter. Professor William Beranek, acting as editorial consultant for the publisher, has made countless valuable suggestions. My colleagues, Professors Charles Bown and Alex Whitmore, read earlier drafts of the manuscript and made helpful observations. Mr. Louis Tihanyi also contributed several valuable comments. Mr. Russ Moore and Mr. Mike Barry, my student assistants, performed a multitude of services. Secretarial services, sometimes under frenzied conditions, were ably and cheerfully performed by Mesdames Cooper, McLean, Olsen, and Rowatt.

I am indebted to Mr. Roger Smith, C.A., and the Invermere office of Thorne, Gunn, Helliwell and Christenson for smoothing out many of the physical details associated with the preparation of the first draft. Finally, I wish to thank the University of Saskatchewan for providing some research funds and secretarial assistance. My colleague, Dean L. I. Barber, was especially helpful in arranging this.

Of course, I bear personal responsibility for any errors which the text may contain.

Glen A. Mumey

Saskatoon, Canada
April 1968

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THEORY OF FINANCIAL STRUCTURE

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BASIC FINANCIAL PROCESSES AND OBJECTIVES

The purpose of this book is to set forth theory leading to the determination of a firm's financial structure, the blend of claims against the firm's assets. In the process we will attempt to identify the cost of funds used by an enterprise, whether these funds are derived from creditors or from owners, and to examine procedures which attempt to minimize these costs. Analysis will be directed as well toward the appropriate amount of financing to be done, or, via the balance-sheet equation, the amount of assets that should be acquired. While no effort will be made to treat detailed techniques for selecting specific assets, broad inquiry into the principles of asset selection will also be made.

THE CONCEPT OF AN ASSET

The number of definitions of *asset* are legion. What this analysis needs is a pragmatic concept that can clarify the view of just what the firm is financing. So let us use this simple description: An asset is a stock a firm has accumulated by acquiring goods and services at a rate greater than it disperses them. The type of goods is not specified; anything accumulated by the firm will do. No notion of the value of the goods is included in the definition. That valuation will be included in the decision of whether or not the asset should be acquired.

Note that cash itself can be held and used in the production process (for example, "till money"). In effect, the enterprise, by abstention from other purchases, uses funds to buy a cash position. Thus, holdings of money fit into our definition of an asset. Since this book is not about asset selection, we will not refine our definition further, but consider cash as part of the "stock of goods that a firm acquires."

LOSS COVERAGE, "FORCED INVESTMENT," AND PAYMENTS TO CAPITAL SUPPLIERS

One may immediately ask: Are asset purchases the only financing need? Is not financing sometimes required to cover economic losses? Consider the case where a storekeeper is successfully sued for $100,000. This $100,000 claim reduces the value of the existing assets of the store. Hence, the loss represents a deterioration in the value of existing assets and does not require funds. Only the separate decision of asset purchase (including replacement purchases) does.

The same analysis holds when considering "forced" asset purchase. A municipality may require that a firm spend $100,000 for a smoke filter on a chimney if it wishes to use the chimney. Again, the $100,000 represents a deterioration in the value of existing plant; the firm has the election of spending $100,000 for the privilege of continuing to operate its facilities. It need not; if the offending plant is already a marginal one, it may well decide to abandon operations.

Besides asset purchases, a common use of funds is in disbursements to creditors and, through dividends and other liquidations, to owners. These disbursements, however, are associated with assignations of assets as part of the financing process. The firm may wish financing so that it may retain particular assets rather than liquidate them to satisfy capital suppliers. Again, asset holding proves to be the underlying motivation in situations where financial disbursements "require" financing or "refinancing."

PRIVATE VERSUS PUBLIC FINANCIAL DECISIONS

In this book an attempt will be made to develop an analysis that is pertinent to financing problems of all enterprises, whether private or publicly owned. Hospitals, highways, and missiles are all assets which require financing in the same way that steel mills and automobile installment plans do. Both private and public entities can be assumed to endeavor to do the same thing—to produce services efficiently. They differ in that the services of the public entity are frequently not sold, but are instead "provided."

However, if the public enterprise is to function efficiently, it is compelled to place a money value on the services it provides. Otherwise it has no common unit of measure by which to compare its services with its costs for purposes of efficiency measurement. Once this monetary evaluation of services has been made, the benefits or services of the public unit become, in decision-making, equivalent to revenues. Output has been measured in the same terms as in the marketplace.

When this similarity is effected, there is, in principle, no difference in the decision processes. Both wish to husband resources, so both seek to minimize costs. Both ordinarily are financed partly by owners (or taxpayers), so both

must reckon opportunity costs on the employment of owners' resources as well as explicit costs of inputs that are purchased from nonowners. In summary, both can be expected to follow the same modus operandi in their quest for efficiency. They attempt to maximize the spread between total value of inputs used and total value of outputs generated.

Rather than attempt to make constant references to the two types of enterprise, or to introduce compromise, both-embracing terminology, we will instead adopt the terminology of the firm, since this is the area around which most recent finance literature has been centered. Thus the later use of the term *revenue* can be thought of as meaning either revenue or identified public benefit, and the use of the word *firm* can be construed as either a business or a public institution. If it is necessary to note differences, or reinforce comparisons, this will be done explicitly. For example, one section of this book will be devoted to the reckoning of equity capital costs in public enterprises.

THE PRODUCTION PROCESS

The theoretical aspects of finance can be viewed as a subset of general economic theory. Since the firms which undertake financing are engaged in producing goods and services of one kind or another, it is appropriate to begin a study of financial theory with a consideration of the economics of production. Assets are required in almost all production processes and these assets in turn require financing. Efficient procurement of financing is just as important a part of a production process as efficient acquisition of labor or raw materials.

Privately and publicly owned enterprises exist for some purpose, for the provision of some service. Both accomplish this by combining resource inputs. If one wishes to describe the production process abstractly, he does so via a production function which describes the amount of services or output that environmental conditions will allow him to obtain within a given period of time from various quantities and types of inputs.

For example, begin with the following definitions:

Q = Quantity of output of a particular good per time-period
I = Quantity of a single input per time-period, the only input used in the production of the output referred to in the definition of Q

A simple production function might consist of

$$Q = 3\,I \qquad [1.1]$$

which describes a condition where three units of input per time-period will generate one unit of output per time-period.

When the physical quantities in the production function are multiplied by relevant unit costs and prices, cost and revenue functions can be assembled. We can add the following definitions:

C = Total cost per time-period = Input per time-period (I) multiplied by unit input price

R = Total revenue per time-period = Output per time-period multiplied by unit output price

Equation 1.1 can be rearranged into

$$I = Q/3 \qquad [1.2]$$

If the unit input price is assumed to be \$1, it follows from the definition of cost that

$$C = \$1.00\,(I) \qquad [1.3]$$

Substituting from equation 1.2

$$C = \$.33\,(Q) \qquad [1.4]$$

Thus a conventional total-cost function has been assembled from the production function and price data. Similarly, if an output price of \$5 is assumed,

$$R = \$5.00\ (Q) = \$1.67\ (I) \qquad [1.5]$$

Revenue is thus expressed either as a function of output produced or of quantity of inputs employed.

Since production processes are normally not instantaneous, practically every production endeavor requires the accumulation of a stock of assets. Workers must be paid before the product is finished, and this payment becomes embodied in a work-in-process inventory. Buildings and machinery must often be acquired. Patents and franchises may have to be bought or developed through research programs. These stocks of assets become inputs in the production process, generating services that mix with labor, raw material, and other input flows.

A stock of assets, or capital, is one of the inputs normally contained in a production function. Since it is possible to identify changes in output that occur when capital is inserted or withdrawn, one can, by holding other inputs constant, identify a production function for one particular input such as capital. (This type of production function, where some inputs are held constant, is called a "limited" production function.) Since there may be many different types of capital, one can envision a production function for each asset possibility.

Consider another example of a simple production function, using the following definitions:

Q = Output of a particular product per month
A = Average stock of assets employed in the production process for the above product, measured in dollars
L = Number of man hours of labor used per month in producing the above product

The following production function is assumed to hold:

$$Q = \sqrt{AL} \qquad [1.6]$$

If both this function and the prices of inputs (the pay rate for an hour's labor and the money interest payment for using a dollar for a month) are known, it is possible to solve for an optimum combination of labor and asset. One can obtain this solution by recalling the standard "optimum input mix" equation from elementary accounting theory:

$$\frac{\text{Marginal Physical Product of Input A}}{\text{Price of Input A}} = \frac{\text{Marginal Physical Product of Input B}}{\text{Price of Input B}} \qquad [1.7]$$

where A and B are any two distinct inputs. By deriving marginal product functions from the basic production function and substituting these, along with input prices, into the above optimum input mix equation, the correct ratio of input use is obtained.

To follow through the above examples, suppose labor must be paid at $2 per hour, and capital at $.01 per $1 per month (12 percent per annum). The marginal product functions which emerge from the above production function 1.6 are obtained by taking partial derivatives. Differentiating equation 1.6 with respect to A, one obtains

$$\text{Marginal Physical Product of Asset} = \frac{\sqrt{L}}{2\sqrt{A}} \qquad [1.8]$$

Differentiating 1.7 with respect to L, one obtains

$$\text{Marginal Physical Product of Labor} = \frac{\sqrt{A}}{2\sqrt{L}} \qquad [1.9]$$

Substituting from 1.8 and 1.9 into the optimum input mix equation 1.7, where asset and labor are inputs A and B, one obtains

$$\frac{\sqrt{L}/2\sqrt{A}}{.01} = \frac{\sqrt{A}/2\sqrt{L}}{2} \qquad [1.10]$$

Solving,

$$A = 200\,L \qquad [1.11]$$

Therefore (at any level of output, given the terms of this example), the number of man-hours used per month should be multiplied by $200 to obtain the optimum asset amount.

To continue the review of basic production economics, one can also proceed to a solution for an optimum output level. To do this an additional element of information is needed: the marginal revenue attributable to output increments. The solution will now follow well-known marginal cost equal marginal revenue lines. The Marginal Cost per Unit of Output is given by

$$\frac{\text{Marginal Cost per Unit of Input}}{\text{Marginal Physical Product per Unit of Input}} = \text{Marginal Cost per Unit of Output}$$

For example, if a marginal unit of input costs $1 and will produce one-half unit of product, $2 worth of this input is required in producing a marginal unit of product.

Optimum output can be identified by determining Marginal Cost per Unit of Output equations, as above, for each input and injecting each input into the production process until marginal cost attributable to that input is equal to marginal revenue. Note that a producer will continue to add more of each input until

$$\frac{\text{Marginal Cost per Unit of Input}}{\text{Marginal Physical Product per Unit of Input}} = \text{Marginal Revenue}$$

If this equation is inverted, it reads

$$\frac{\text{Marginal Physical Product per Unit of Input}}{\text{Marginal Cost per Unit of Input}} = \frac{1}{\text{Marginal Revenue}}$$

Since the value of 1/ Marginal Revenue is the same no matter what input is being used, all values of Marginal Physical Product per Unit of Input/ Marginal Cost per Unit of Input are set equal to a common value, and hence equal to each other. The reader will note that this last equality is equivalent to the necessary condition for an optimum input mix; that is, Equation 1.7, since Marginal Cost per Unit of Input is the same as the factor price when factor prices remain constant as inputs are added.

THE FINANCING PROCESS

If marginal inputs, which may include assets, are added until marginal revenue equals marginal cost, assets are in optimum proportion with each

other and are being used as part of an optimum-scale (level-of-output) production process. The problem now is to translate this economics construct into a useful decision rule for the firm's financing process. To do this, we need to examine the asset-acquisition process.

Assets must be paid for with money or money-equivalent. Normally this means that a stock of money must be available in an amount equal to the contemplated cost of the asset. This relationship is equally true whether the asset is a machine being bought from an outside supplier, or an accounts receivable position accumulating as a firm incurs production costs but obtains no cash revenues from sales.

In general, there are two ways by which a firm accumulates money stocks. The first of these is the buildup of money when goods and services are sold at a rate of flow per unit of time greater than money outflows for purchases. These cash flows from transactions must be distinguished from the usual accounting-income concept, which makes a reckoning of noncash revenues and expenses as well as cash items. For example, the sale of goods on credit, normally recognized as a revenue in existing accounting usage, does not generate cash. The sales process, in fact, uses up cash, so the conversion of inventory into receivables usually results in the need to feed more cash into the production process; that is, to accumulate additional assets. As another example, the sale of plant at "book value" may generate cash without showing up in a conventional income statement.

Besides the residual from asset transactions, asset-purchasing power can also be generated in another way—from outside sources. Money can be lent by banks, subscribed by stockholders, or, in the case of governmental units, taxed away from citizens. While the use of some of it may be restricted to particular purposes, it can, of course, be mixed with money generated through transactions.

THE ASSET-ACQUISITION DECISION

The value of an asset lies in its productive power. An asset when placed in service can generate cash either by enabling an increase in sales or a reduction in purchases of other inputs. The increase in net cash flows attributable to the accumulation of an asset or group of assets provides the quid pro quo for that accumulation. One need not distinguish between whether the original asset is itself eventually sold or whether cash flows originate in other ways. He need be interested only in the quantitative cash effect of acquiring the asset. His asset purchase is desirable to the extent that the amount and timing of cash received compare favorably with the cash outlays associated with the asset's purchase.

These money recoveries occur after the original outlay for the asset. Thus one can identify a rate of increase (or decrease) per unit of time that