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MANAGERIAL ECONOMICS

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Fifteenth Edition

15e

Managerial Economics

Mark Hirschey
University of Kansas

Eric Bentzen
Copenhagen Business School

Carsten Scheibye
Copenhagen Business School

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Dedication

To Christine
(Mark Hirschey)

To Birgitte
(Eric Bentzen)

To Susanne
(Carsten Scheibye)

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About the Authors

Eric Bentzen (Copenhagen Business School) is Associate Professor at Copenhagen Business School, where he teaches undergraduate and graduate courses in Managerial Economics and Business Analytics. He is a member of several professional organizations. He has published in *Applied Financial Economics*, *European Journal of Finance*, *Management Decision*, *Financial Markets and Portfolio Management,* and other leading academic journals.

Carsten Scheibye (Copenhagen Business School) is Assistant Professor at Copenhagen Business School, where he teaches undergraduate courses in Managerial Economics. He has significant experience in course coordination and management as well as within didactical and pedagogical development of the learning environment surrounding the field of Managerial Economics. In addition, he has received educational prizes for his teaching abilities. Among these are the Education Prize from the Danish Society of Business and Education.

The late **Mark Hirschey** (University of Wisconsin-Madison) was the Anderson W. Chandler Professor of Business at the University of Kansas, where he was teaching undergraduate and graduate courses in managerial economics and finance. Professor Hirschey was president of the Association of Financial Economists and a member of several professional organizations. He has published articles in the *American Economic Review*, *Review of Economics and Statistics*, *Journal of Business*, *Journal of Business and Economic Statistics*, *Journal of Finance*, *Journal of Financial Economics*, *Journal of Industrial Economics,* and other leading academic journals. He was editor of *Advances in Financial Economics,* and past editor of *Managerial and Decision Economics*.

Preface

Economic concepts show how to apply common sense to understand business and solve managerial problems. Economic intuition is really useful. It helps managers decide on which products to produce, costs to consider, and prices to charge. It also helps them decide on the best hiring policy and the most effective style of organization. Students and future managers need to learn these things. The topics covered in managerial economics are powerful tools that can be used to make managers more effective and their careers more satisfying. By studying managerial economics, those seeking to further their business careers learn how to more effectively collect, organize and analyze information.

A key feature of this book is its depiction of the firm as a cohesive organization. Effective management involves an integration of the accounting, finance, marketing, personnel, and production functions. This integrative approach demonstrates that important managerial decisions are *interdisciplinary* in the truest sense of the word.

Although both microeconomic and macroeconomic relations have implications for managerial decision-making, this book concentrates on microeconomic topics. Following development of the economic model of the firm, the vital role of profits is examined. Because economic decision-making often requires an elementary understanding of optimization techniques and statistical relations, those basic concepts are described early in the text. Because demand for a firm's products plays a crucial role in determining its profitability and ongoing success, demand analysis and estimation is an essential area of study. An important part of this study is an investigation of the basic forces of demand and supply. This naturally leads to discussion of economic forecasting and methods for assessing forecast reliability. Production theory and cost analysis are then explored as means of understanding the economics of resource allocation and employment.

Once the internal workings of a successful firm are understood, attention can turn towards consideration of the firm's external economic environment. Market structure analysis provides the foundation for studying the external economic environment and for defining an effective competitive strategy. The role of government in the market economy, including the constraints it imposes on business, requires a careful examination of regulation and antitrust law. Risk analysis and capital budgeting are also shown as methods for introducing marginal analysis into the long-range strategic planning and control process. Finally, given government's increasing role in managing demand and supply for basic services, such as education and healthcare, the use of economic principles to understand and improve public management is also considered.

Managerial Economics, 15th Edition, takes a practical problem-solving approach. The focus is on the economics—not the mathematics—of the managerial decision process. Quantitative tools are sometimes employed, but the emphasis is on economic intuition.

THIS 15TH EDITION

Students and instructors will find that *Managerial Economics*, 15th Edition, provides an efficient calculus-based introduction and guide to the optimization process. Chapter 2, 'Economic Optimization', illustrates how the concept of a derivative can be used as a practical tool to understand and apply marginal analysis. 'Multivariate Optimization and the Lagrangian Technique', Appendix 2B, examines the optimization process for equations with three or more variables. Such techniques are especially helpful when managers face constrained optimization problems, or decision situations with limited alternatives. Throughout the text, a wide variety of problems describing real-world decisions can be solved using such techniques.

Managerial Economics, 15th Edition provides an intuitive guide to model building, analysis and basic economic relations. Although differential calculus is an obviously helpful tool for understanding the process of economic optimization, it is important that students not let mathematical manipulation get in the way of their basic grasp of economic concepts. Although those using a non-calculus-based approach can safely skip parts of Chapter 2 and Appendix 2B, all other material is fully and completely assessable. With practice using a wide variety of problems and examples throughout the text, all students are able to gain a simple, practical understanding of how economics can be used to understand and improve managerial decisions.

Learning Aids

- Each chapter incorporates a wide variety of simple numerical examples and detailed practical illustrations of chapter concepts. These features portray the valuable use and real-world implications of covered material.
- Each chapter includes short Managerial Applications boxes to show current examples of how the concepts introduced in managerial economics apply to real-world situations. New Managerial Applications based on articles from the Internet or *Barron's*, *Business Week*, *Forbes*, *Fortune*, and *The Wall Street Journal* are provided. This feature stimulates student interest and offers a popular basis for classroom discussion.
- The book incorporates several new regression-based illustrations of chapter concepts using actual company data, or hypothetical data adapted from real-world situations. Like all aspects of the text, this material is self-contained and intuitive.
- Effective managers must be sensitive to the special challenges posed by an increasingly global marketplace. To increase student awareness of such issues, a number of examples, Managerial Applications, and case studies that relate to global business topics are featured.
- Selected chapters are accompanied by a case study that provides in-depth treatment of chapter concepts. To meet the needs of all instructors and their students, these case studies are written to allow, but do not require, a computer-based approach. These case studies are fully self-contained and especially helpful to instructors who wish to more fully incorporate the use of basic spreadsheet and statistical software in their courses.
- New end-of-chapter questions and problems are provided, after having been subject to necessary revision and class testing. Questions are designed to give students the opportunity to grasp basic concepts on an intuitive level and express their understanding in a nonquantitative fashion. Problems cover a wide variety of decision situations and illustrate the role of economic analysis from within a simple numerical framework.

- Each chapter includes self-test problems with detailed solutions to show students how economic tools and techniques can be used to solve practical business problems. These self-test problems are a proven study aid that greatly enhances the learning value of end-of-chapter questions and problems.

Companion Website

Managerial Economics, 15th Edition is supported by a Companion Website to help make teaching and learning the material both easy and enjoyable.

Acknowledgments

We are indebted to staff at Cengage Learning for making the 15th edition a reality.

A number of people have aided in the preparation of *Managerial Economics*. Helpful suggestions and constructive comments have been received from a great number of instructors and students who have used previous editions. Numerous reviewers have also provided insights and assistance in clarifying difficult material. Among those who have been especially helpful in the development of previous editions are: Barry Keating, University of Notre Dame; Stephen Conroy, University of San Diego; Xu Wang, Texas A&M University; Michael Brandl, University of Texas, Austin; Neil Garston, California State University, Los Angeles; Albert Okunade, University of Memphis; David Carr, University of South Dakota; Steven Rock, Western Illinois University; Mel Borland, Western Kentucky University; Tom Staley, San Francisco State University.

Many thanks to the reviewers of this edition, Gu Guowei of London South Bank University, UK and Dr Tendeukayi Mugadza of Monash University, South Africa.

Every effort has been made to minimize errors in the book. However, errors do occasionally slip through despite diligent efforts to provide an error-free package of text and ancillary materials. Readers are invited to correspond with me directly concerning any corrections or other suggestions.

It is obvious that economic efficiency is an essential ingredient in the successful management of both business and public-sector organizations. Like any dynamic area of study, the field of managerial economics continues to undergo profound change in response to the challenges imposed by a rapidly evolving environment. It is exciting to participate in these developments. I sincerely hope that *Managerial Economics* contributes to a better understanding of the usefulness of economic theory.

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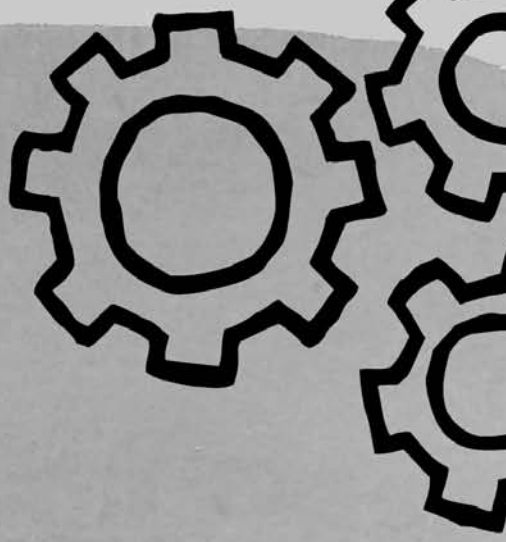

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Overview of Managerial Economics

PART 1

CHAPTER 1
Nature and Scope of Managerial Economics

CHAPTER 2
Economic Optimization

CHAPTER 3
Demand and Supply

Nature and Scope of Managerial Economics

CHAPTER 1

Bill Gates, founder of Microsoft Corporation, launched Microsoft together with Paul Allen back in 1975. Microsoft became the largest PC company in the world. From 1995 to 2017 Gates held the *Forbes* title as one of the richest persons in the world, with an estimated net worth of $91.7 billion as of February 2018.

Bill Gates' success is powerful testimony to the practical usefulness of managerial economics. Managerial economics answers fundamental questions. When is the market for a product so attractive that entry or expansion becomes appealing? When is exit preferable to continued operation? Why do some professions pay well, while others offer only meagre pay? Successful managers make good decisions, and one of their most useful tools is the methodology of managerial economics.

HOW IS MANAGERIAL ECONOMICS USEFUL?

Economic theory and methodology lay down rules for improving business and public policy decisions.

Evaluating Choice Alternatives

managerial economics
Applies economic tools and techniques to business and administrative decision-making.

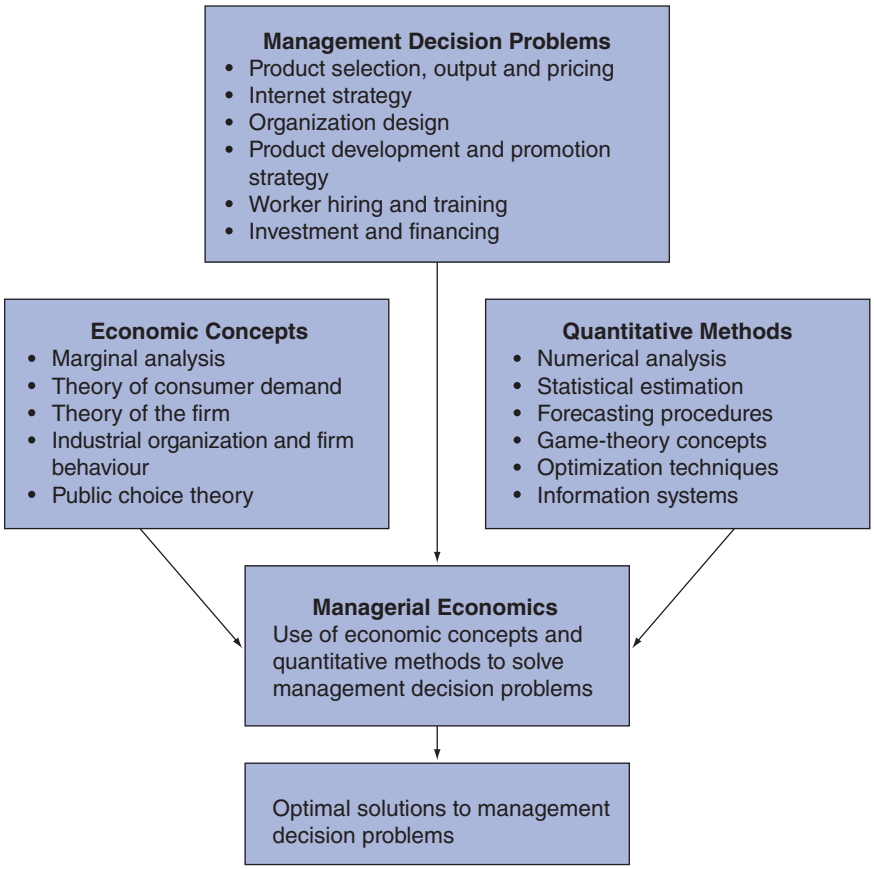
Managerial economics helps managers recognize how economic forces affect organizations and describes the economic consequences of managerial behaviour. It also links economic concepts, data and quantitative methods to develop vital tools for managerial decision-making. This process is illustrated in Figure 1.1.

Managerial economics identifies ways to achieve goals efficiently. For example, suppose a small business seeks rapid growth to reach a size that permits efficient use of national media advertising; managerial economics can be used to identify pricing and production strategies to help meet this short-run objective quickly and effectively. Similarly, managerial economics provides production and marketing rules that permit the company to maximize net profits once it has achieved growth or market-share objectives.

Managerial economics has applications in both profit and not-for-profit sectors. For example, an administrator of a nonprofit hospital strives to provide the best medical care possible given limited medical staff, equipment, and related resources. Using the tools and concepts of managerial economics, the administrator can determine the optimal allocation of these limited resources. In short, managerial economics helps managers arrive at a set of operating rules that aid in the efficient use of scarce human and capital resources. By following these rules, businesses, nonprofit organizations and government agencies are able to meet objectives efficiently.

Figure 1.1 Managerial Economics is a Tool for Improving Management Decision-Making

Managerial economics uses economic concepts and quantitative methods to solve managerial problems.



Managerial Decision-Making

Managerial decision-making problems very often have many impacts, some of them immediate, and others more modest. In order to make decisions we need information. Sometimes all the relevant information we need is readily available and we can effectively use this information in the decision-making process. In other settings, information may be available, but we cannot effectively use it because of limitations. Many decision problems are complicated due to uncertainty. When we have a decision problem with uncertain information we can use two different ways to reach a decision. One is to simulate different combinations of the outcome. Another is to use mathematical and statistical methods to calculate the expected value of the outcome. Even with maths and statistics there are many decision problems that are highly complex. With scarce resources, the different outcomes must be evaluated. When addressing a complex problem, there are typically no signs that indicate which are the important relationships that must be maintained and which can be ignored.

Therefore, model-building is a simplification or an abstract representation of an existing problem and choosing what to include and what to exclude requires experience. But there are a number of important steps in model-building that can be useful to managerial decision-making. Managerial economics offers a comprehensive application of economic theory and methodology to management decision-making.

Little (1970)[1] argued that the problem with management models is that managers never use them. But he also argued that the reason can be found in the difficulty of implementing a managerial decision model, and the different language managers use compared with the one used in mathematical models.

If we want a decision-maker to use a model, the decision-maker must perceive the owner of the model.

A decision model should have the following structure:

a) It should be simple – because it promotes ease of understanding. The most important 'drivers' should be included in a model, and the unimportant should be left out.
b) It should be robust – solutions should include a range of expected values.
c) It should be easy to control – changes of the model should be easy to do.
d) It should be updated – a model should be easy to update as new information becomes available.
e) It should be easy to communicate with – a decision model should easily give 'what-if' answers.

Managerial Application 1.1

Business Ethics

In the *Financial Times* you sometimes find evidence of unscrupulous business behaviour. However, unethical conduct is inconsistent with value maximization and contrary to the enlightened self-interest of management and other employees. If honesty didn't pervade corporations, the ability to conduct business would collapse. Eventually, the truth always comes out, and when it does the unscrupulous lose out. For better or worse, we are known by the standards we adopt. To become successful in business, everyone must adopt a set of principles. Ethical rules to keep in mind when conducting business include:

- Above all else, keep your word. Say what you mean, and mean what you say.
- Do the right thing. A handshake with an honourable person is worth more than a ton of legal documents from a corrupt individual.
- Accept responsibility for your mistakes, and fix them. Be quick to share credit for success.
- Leave something on the table. Profit *with* your customer, not *off* your customer.
- Stick by your principles. Principles are not for sale at any price.

Does the 'high road' lead to corporate success? Consider the experience of A.P. Moller–Maersk – a Scandinavian company. The founder of A.P. Moller–Maersk used the phrase 'no loss should hit us, which by due diligence could be averted'.

See: www.maersk.com

1 Little, J.C. 'Models and Managers: The concept of a decision calculus'. *Management Science*. 1970, Vol. 16, No. 8, B466–B48.

The managerial decision-modelling process

There are a number of stages in the managerial decision-making process. The process should be regarded as an iterative process between the stages.

We define the three stages as: 1) Formulation, 2) Solution, 3) Interpretation.
Each of the three stages has its own steps which should be considered. They are:

1) **Formulation**: Problem formulation, Model construction, Input data.
2) **Solution:** Determining a solution, Testing the solution.
3) **Interpretation:** Analyzing and interpretation of the solution, Sensitivity Analysis, Implementation.

1) **Formulation**
   Formulation of the problem is a process where the problem is translated from the practical problem into a mathematical model. A poorly or insufficiently formulated model will result in a bad solution and ultimate misinterpretation. Therefore, the formulation stage can be regarded as a challenge and the most difficult part, and at the same time it also shows the direction and extension of the problem. It is not uncommon that failure of managerial decision-making models can be traced directly back to the formulation of the original problem. The limits of the problem as well as the degree to which it pervades other units of the organization must be included.

   - **Problem formulation**
     Start by developing a clear and short statement of the problem. Sometimes this initial analysis results in conflicting viewpoints. Identify a specific measurable objective that clearly states the real problem. This objective could very well be the goals of the organization.
   - **Model construction**
     A managerial decision model is an abstract representation of an existing problem. The essential feature of a managerial decision model is that it involves a set of mathematical relationships, e.g. equations, inequalities, logical dependencies, which correspond to some more down-to-earth relationships in the real world, e.g. technological relationships, marketing constraints, capital, and labour constraints.

     Remember that no model can be an exact representation of reality. We are bound to paint a stylized and somewhat distorted picture of the problem. In any model, complex interactions are simplified, and detail is summarized or omitted. Begin with a simple model that just explain a single main effect.

     Start by stating the assumptions of the problem and define the variables. These variables can be those that are controllable (i.e., our decision variables), and those variables that are uncontrollable. To distinguish between these more precisely, look at the factors that determine demand. If we identify the factors that affect demand for a product we could distinguish between those that are controllable and those that are uncontrollable factors. Within a company controllable demand factors are price, product, promotion and place. And uncontrollable demand factors are income, taste, competitive factors, government policy, demographic factors, climatic factors, macroeconomic factors, prices of substitutes and complements, etc.
   - **Input data**
     After having developed a model, we have to find input data to be used in the model. Obtaining data is very important because a well-specified model could be misleading if it contains improper data. Ask yourself what data are relevant, and how the relevant data can be found. It is a good idea to be sensitive to data,

and very useful to check the facts, particularly the numbers that everyone in the organization believes to be true. Sometimes numbers may be myths – justifiers of organizational practice – or they might once have been true.

2) **Solution**
For many years courses in managerial decision-making focused most of their attention on this step, because the step involved mathematical skills to solve complicated and sometimes complex problems. Here we will move away from the detailed steps of the solution process and instead we will use software packages to do the hard work.

- **Determining a solution**
Determining a solution is an iterative process where the model is used to arrive at the optimal (or best) solution to the problem. Sometimes this may require a set of mathematical equations and sometimes you can use trial-and-error methods and pick the best solution. We will often use a software package to do the more complex computations. These computations often use an algorithm which is a series of steps and procedures that are repeated until a solution has been found.
- **Testing the solution**
Testing the solution is a process of examining whether model and input match. Often test results will cause the model to change in accordance with defects or omissions. If something is missing, you expand the model, and then again check the model and data match. The iteration goes on until the decision-maker is satisfied.

3) **Interpretation**
Interpreting the results can be a difficult and often professional challenge. It may provide a solution to the problem posed or point to the need to gather additional information.

- **Analyzing and interpretation of the solution**
Analyzing and interpreting the solution will determine the implications and perhaps the problems that a decision can cause. It could give rise to a change of marketplace, prices, costs, or the organization.
- **Sensitivity analysis**
A significant part of the interpretation will be to establish sensitivity analyzes for the proposed solution.

  A sensitivity analysis indicates how sensitive the result will be to changes in model parameters and variations. Sensitivity analysis shows how the solution will change with different parameters or input data. Further, the sensitivity analysis can show the dynamics of the model.
- **Implementation**
Implementing the results can be even more challenging. Often it will involve more employees in an organization that may not have understood the entire probability setting, model or solution. It can be a long-standing process that can extend over several years. Changing the IT platform in a company is an example of a change that may extend over time. Another is the modelling and managing the performance of airports.[2]

THEORY OF THE FIRM

Firms are useful for producing and distributing goods and services.

2 Zografos, K., Giovanni A, and Odoni, A. *Modelling and managing airport performance*, Wiley, 2013.

Expected Value Maximization

At its simplest level, a business enterprise represents a series of contractual relationships that specify the rights and responsibilities of various parties (see Figure 1.2). People directly involved include customers, stockholders, management, employees, and suppliers. Society is also involved because businesses use scarce resources, pay taxes, provide employment opportunities, and produce much of society's material and services output. The model of business is called the **theory of the firm**. In its simplest version, the firm is thought to have profit maximization as its primary goal. The firm's owner-manager is assumed to be working to maximize the firm's short-run profits. Today, the emphasis on profits has been broadened to encompass uncertainty and the time value of money. In this more complete model, the primary goal of the firm is long-term **expected value maximization**.

theory of the firm
Basic model of business.

expected value maximization
Optimization of profits in light of uncertainty and the time value of money.

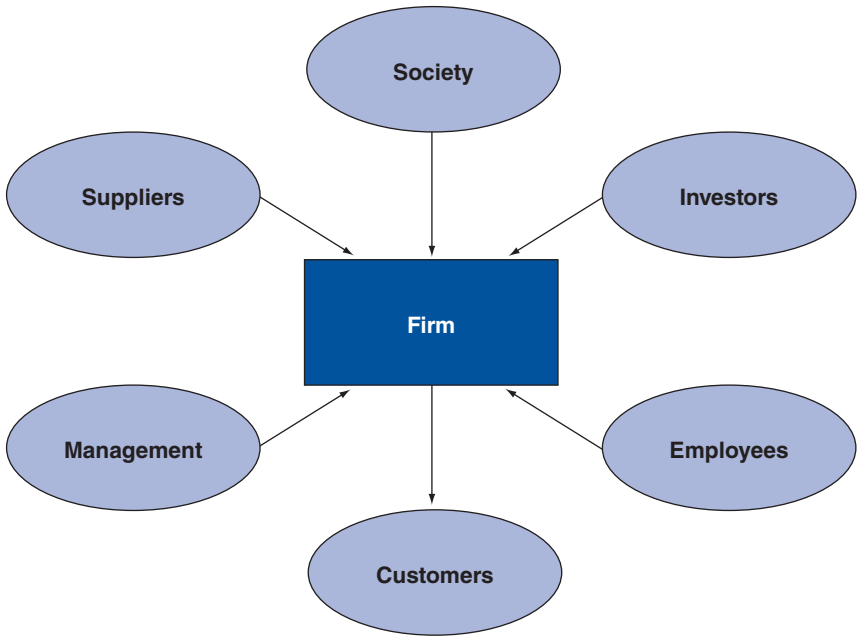
The **value of the firm** is the present value of the firm's expected future net cash flows. If cash flows are equated to profits for simplicity, the value of the firm today, or its **present value**, is the value of expected profits, discounted back to the present at an appropriate interest rate.[3]

value of the firm
Present value of the firm's expected future net cash flows.

present value
Worth in current money.

Figure 1.2 The Corporation is a Legal Device

The firm can be viewed as a series of contractual relationships that connect suppliers, investors, workers and management in a joint effort to serve customers.



3 Discounting is required because profits obtained in the future are less valuable than profits earned presently. One euro today is worth more than €1 to be received a year from now because €1 today can be invested and, with interest, grow to a larger amount by the end of the year. One euro invested at 10 per cent interest would grow to €1.10 in one year. Thus, €1 is defined as the present value of €1.10 due in one year when the appropriate interest rate is 10 per cent.

This model can be expressed as follows:

$$\begin{aligned}\text{Value of the Firm} &= \text{Present Value of Expected Future Profits} \\ &= \frac{\pi_1}{(1+i)^1} + \frac{\pi_2}{(1+i)^2} + \cdots + \frac{\pi_n}{(1+i)^n} \\ &= \sum_{t=1}^{n} \frac{\pi_t}{(1+i)^t}\end{aligned} \quad \textbf{1.1}$$

Here, $\pi_1, \pi_2, \ldots, \pi_n$ represent expected profits in each year, t, and i is the appropriate interest, or discount, rate. The final form for Equation (1.1) is simply a shorthand expression in which sigma (Σ) stands for 'sum up' or 'add together'. The term

$$\sum_{t=1}^{n}$$

means, 'Add together as t goes from 1 to n the values of the term on the right'. For Equation (1.1), the process is as follows: Let $t=1$ and find the value of the term $\pi_1/(1+i)^1$, the present value of year 1 profit; then let $t=2$ and calculate $\pi_2/(1+i)^2$, the present value of year 2 profit; continue until $t=n$, the last year included in the analysis; then add up these present value equivalents of yearly profits to find the current or present value of the firm.

Because profits (π) are equal to total revenues (TR) minus total costs (TC), Equation (1.1) can be rewritten as:

$$\text{Value} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+i)^t} \quad \textbf{1.2}$$

This expanded equation can be used to examine how the expected value maximization model relates to a firm's various functional departments. The marketing department often has primary responsibility for promotion and sales (TR); the production department has primary responsibility for development costs (TC); and the finance department has primary responsibility for acquiring capital and, hence, for the discount factor (i) in the denominator. Important overlaps exist among these functional areas. The marketing department can help reduce costs for a given level of output by influencing customer order size and timing. The production department can stimulate sales by improving quality. Other departments, for example, accounting, human resources, transportation and engineering, provide information and services vital to sales growth and cost control. The determination of TR and TC is a difficult and complex task. All managerial decisions should be analyzed in terms of their effects on value, as expressed in Equations (1.1) and (1.2).

Constraints and the Theory of the Firm

Organizations frequently face limited availability of essential inputs, such as skilled labour, raw materials, energy, specialized machinery and warehouse space. Managers often face limitations on the amount of investment funds available for a particular project or activity. Decisions can also be constrained by contractual requirements. For example, labour contracts limit flexibility in worker scheduling and job assignments. Contracts sometimes require that a minimum level of output be produced to meet delivery requirements. In most instances, output must also meet quality requirements. Some common examples of output quality constraints are nutritional requirements for feed mixtures, audience exposure requirements for marketing promotions, reliability requirements for electronic products, and customer service requirements for minimum satisfaction levels.