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Preface

The second edition of *Managerial Uses of Accounting Information* reflects a decade of teaching this material to a variety of students, ranging from undergraduate sophomores to graduate students as well as a decade of growth in our understanding of information’s role in an organization. While the spirit and intent of the first edition remain, the approach is (I hope) noticeably different. I have learned that a two pronged approach beginning with a stronger focus on fundamentals followed by a presentation of accounting as an artful rendering of those fundamentals is simultaneously clarifying and edifying. Staying slightly closer to the economics of cost, choice and contracting and removing minutia showcase the central ideas in a profoundly more clear fashion.

But as I said, the spirit and intent of the first edition remain. So it seems appropriate to repeat the message in the original Preface.

This book is an invitation to study managerial uses of accounting information. Three themes run throughout. First, the accounting system is profitably thought of as a library of financial statistics. Answers to a variety of questions are unlikely to be found in prefabricated format, but valuable information awaits those equipped to interrogate the library. Second, the information in the accounting library is most unlikely to be the only information at the manager’s disposal. So knowing how to combine accounting and non-accounting bits of information is an important, indeed indispensable managerial skill. Finally, the role of a professional manager is emphasized. This is an individual with skill, talent, and imagination, an individual who brings professional quality skills to the task of managing.
This book also makes demands on the reader. It assumes the reader has had prior exposure to financial accounting, economics, statistics, and the economics of uncertainty (in the form of risk aversion and decision trees). A modest acquaintance with strategic, or equilibrium, modeling is also presumed, as is patience with abstract notation. The book does not make deep mathematical demands on the reader, but neither does it take mathematical shortcuts. An acquaintance with calculus and simple optimization is presumed. (Otherwise the many opportunities to use optimization software such as the Solver routine in Excel will be less than fully digested.) The major prerequisite is a tolerance for (if not a predisposition toward) abstract notation.

This style and list of prerequisites are not matters of taste or author imposition. The study of accounting is serious business; it demands an ability to place accounting in a large environment, complete with uncertainty, strategic considerations, and a fuzzy demarcation between the organization and its environment. A professional quality manager has this ability, and the study of accounting at the level of serious professional encounter demands no less. This is the nature of the subject. To ask less of the reader is to denigrate the art of professional management and to limit unjustly our exploration.

That said, as before, you will find the book purposely void of color and gratuitous photos. Our subject matter is too intellectually intriguing and too important to be treated otherwise.

Intellectual debt in any undertaking of this sort is enormous. You will find selected references at the end of each chapter, chosen to provide a sample of the breadth and depth of the debt in this particular case. I have also tried, in offering these references, to provide a sense of the historical development of this body of knowledge. More personally, I owe a deep intellectual debt to Jerry Feltham, Chuck Horngren, David Kreps, Carl Nelson, David Sappington and Bob Wilson. John Christensen, John Fellingham and especially Sybil Bartel, Haijin Lin and Rick Young provided invaluable encouragement, reading and guidance in the creation of this manuscript.

My largest debt, though, is to my wife Millie. Her constant encouragement, counsel and support have made my studies, my academic career and this project possible and enjoyable.

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1

Introduction

This book invites the reader to study how accounting information is used in the management of an organization. It is a book that deals with accounting; yet the central feature is using the accounting, as opposed to doing the accounting. Stated differently, our study of accounting adopts a managerial perspective. It stresses use of the various accounting products, not their production. Emphasis is placed on use by a well-prepared and responsible manager.

Our study is inspired by the complexity and subtlety of two seemingly innocuous questions: what might it cost, and did it cost too much? Imagine some important decision the organization is facing, such as introduction of a new product. Following the underlying decisions through their natural cycle, the early phase would be concerned with, among other things, what various product design options might cost. Subsequently, with the chosen design in place and in production, we turn to evaluating the managers. Here, among other things, the evaluation would address how much the product actually cost. What might it cost and did it cost too much turn out to be natural, important, recurring questions, questions with a distinctly accounting flavor.

Reigning folklore suggests these are two ways of asking the same basic question, and that the answer is to be found in a well designed accounting system. Yet as comforting as the folklore is, it invites a serious misidentification of how accounting information is used.

What we mean by the cost of something is not a unique, knowable datum. Rather, it depends on the economic circumstances at hand and on how the underlying decision at hand has been framed. There simply is not
1. Introduction

a straightforward or unique answer to the question "what might it cost?" Likewise, when asking whether it cost too much we are engaging in performance evaluation, an inherently retrospective activity. But information that is useful in making a decision is not necessarily useful in evaluating the manager who made that decision, and vice versa. Life, fortunately, is much more complex. And this is what opens the door for a serious study of managerial uses of accounting information. This preamble is, in fact, code for a particular philosophy and approach to the study of accounting. Briefly, accounting is one of many information resources at the disposal of the professional manager. It is a highly useful, sophisticated, and adaptable resource. Used with skill, it can be of considerable value. Used without skill, it can lead to devastating and embarrassing errors. How to use the accounting resource is our focus. There is a temptation to think in terms of rules, recipes, and handy guidelines for this purpose. Yet this is the antithesis of the philosophy and approach expounded here.

Rules, recipes, and handy guidelines for how to use the accounting products are crutches for the less than well-prepared and not so responsible manager. Fortunately, managerial life is more interesting than that. The purposeful use of accounting is critically dependent on the circumstance at hand. The professional quality manager recognizes this and is prepared to add professional judgment to the exercise. Our study can help prepare the manager to make these judgments, but it cannot relieve the manager of their necessity.

The purpose of this introductory chapter is to expand on this theme and provide an overview of our study. Following a brief reminder of the typical array of accounting resources, we examine alternate approaches to the study of accounting. We then discuss the essential ingredients for the exercise to capture the crucial features of the implied managerial task. Finally, we outline the stages of our study.

1.1 Accounting Resources

The organization's accounting system provides a number of important resources. It provides a language. Accounting is often called the "language of business." Liabilities, net worth, bottom line, cost of goods sold, periodic income, and fund balance are all well-used, familiar terms. We often use the language of accounting to convey various facts about a corporation, a partnership, or proprietorship, a not-for-profit entity, a public sector entity, or an entire economy. The focus, in turn, might be the entity as a whole or some part thereof. The widespread use of accounting as a language should be abundantly clear from your prior study of financial accounting.
Accounting also provides a model of consequences. Every organization charts its progress, in part, with its financial statements. A personal debit card statement, GE’s consolidated financial statements, and the University of Florida’s current fund balances provide ready examples.

What might happen to earnings per share? What will opening the new plant do to our balance sheet? Is the (accounting) revenue less the (accounting) cost positive for this product? We often use accounting summarizations to help assess the financial progress of an organization. By implication, then, we often project what we think, expect, or even hope a future accounting summarization might look like if specified policies are pursued. Accounting provides a model of consequences.

The other side to this is that accounting provides a portrayal of the organization that others will see and use. To illustrate, competitors will be interested in one’s public financial record, as will taxation agencies. The astute homeowner will inquire about the insurance company’s financial health, just as the astute professor seeking greener pastures at a competitor will look into budget matters. Similarly, the astute competitor will study the financial strengths of its main competitors.

Finally, accounting is a repository of financial data. It is a well-maintained, structured, and defended financial library. The manager will often find useful information in the accounting library; and the accounting renderings of the manager’s current activities will be deposited in the library.

This library metaphor pervades our study. We do not go to the usual library without an understanding of how the library is organized, nor do we expect to find off-the-shelf ready made answers to every inquiry we bring.¹ Similarly, we know of specialized libraries and have confronted the question of which library to query. Contrast the Law and Social Science Libraries at the University of Florida, for example.² We also know it is sometimes preferable to acquire information on personal account. Typically, we read our daily newspaper at home, without retrieving the newspaper from the library. Similarly, an efficient housing search would begin with a web-based inquiry of the posted options.

The same holds for the accounting library. The professional manager knows how this library is organized and maintained, and how to retrieve

¹Emphatically, we don’t simply Google the accounting library to learn what some product cost. The accounting library is not the sole source of insight; and it is constructed, as you will learn, in highly specific fashion, a fashion that may or may not speak to the decision at hand.

²An important advantage of the accounting library is its reliability. Serious effort is given to defending it against error, or worse. Care is taken to record events with considerable accuracy. Of course, this means some types of information are delayed (or not admitted). Revenue is not recognized when the customer announces an intent to purchase, even though this may be a remarkable, euphoric piece of good news. Rather, revenue is recognized at a later stage, at a time when the veracity of the claim can be better or more easily verified.
information from it. The professional manager also knows what types of
information are likely to be found in the accounting library, and how to
combine that information with information from other sources, including
those sources that are personally maintained.

The professional manager is, among other things, a skilled user of the
accounting library. This skill is the focus of our study.\footnote{A corollary observation is the professional manager has a responsibility to help
manage the accounting library. The acquisition policy at the public library is guided
by consumer tastes, and we expect no less for the accounting library. From the man-
ager’s perspective, the accounting library is one more resource to be efficiently used and
developed.}

1.2 Modes of Study

This brings us to the question of how best to study the art of using the ac-
counting library. One method might be labeled the "imperative." The idea
is to decree or divine how the accounting should be performed and used.
This is how revenue should be measured, this is how product cost should
be measured, this is how performance relative to budget for the division
manager should be measured. All are expressions of this philosophy.

While admittedly a red herring, it is worthwhile at the outset to dispense
with the imperative theme. At one level it creeps in when financial reporting
is encountered. This is a consequence of regulation. GAAP requiring this or
that treatment is a common theme. This subtly shades into an imperative.
After all, while accounting can be confusing, we can at least rely on GAAP
to give it structure. GAAP is comfortable in this regard; it implies a widely
applicable, correct answer to the question of how the accounting should be
done.

At another level, I, personally, have found this imperative mode depress-
ingly endemic to accounting. My students are usually frustrated and dis-
appointed when "good" accounting is not identified. They seem to want a
correct answer, an imperative. (It is one thing to identify a correct calcu-
lation of product cost, given an announced algorithm, and quite another
to pick the algorithm.) After all, GAAP itself is all about learning and
following the rules of a regulatory agency. Yet these same students would
be sadly disappointed if their economics professor advocated the best allo-
cation of a family’s budget without reference to tastes, opportunities, and
prices. Family budget allocations are influenced by economic forces, and
the same goes for accounting.

So it should be made clear at the start: we will treat the accounting
library as one among many resources at the manager’s disposal. It is an
economic resource. How best to construct it and how best to use it depend
in such critical fashion on the circumstance at hand that general guidelines
and rules of thumb are not available. Professional judgment is required, in
the same way that it is required when a new product is launched, when
an R&D project is contemplated, or when an evaluative conference with a
subordinate is being planned.

If not adopting the "imperative school," then how are we to proceed?
Another alternative is the codification approach. Here we document prac-
tice, including the latest consulting products, looking for commonalities
and so-called best practices. Variety is to be expected. For example, mu-
icipalities tend to use recognition rules that formally record a purchase
order as an expense. This is done to keep detailed track of commitments
because spending limits are strictly enforced. The commercial organization
uses a slower recognition rule but also keeps close track of purchases in
its cash management operations. Similarly, hospitals tend to use elaborate
product costing systems, while airlines do not think in terms of the cost
of serving an individual customer. Of course, the hospital faces de facto
cost-based pricing\(^4\) while the airline adopts more of a system or network
view of its products.

Here we run the risk of being overwhelmed by detail, and not taking care
to identify and document what forces are shaping the accounting products.
We invite a bias toward the status quo, and sidestep the question of what
distinguishes a best from a less than best practice. Today’s best practice
is worthy of scrutiny and imitation. Yet our task extends from today to
tomorrow to well beyond tomorrow.

The remaining interesting alternative is a conceptual approach. This
emphasizes an image, a mental image, of the library and circumstance
at hand. Several advantages follow. Our image must combine library and
circumstance. We are therefore forced to provide a conceptual or generic
description of a typical accounting library. This we will do in terms of ag-
gregation, well chosen approximations to the organization’s cost curve, and
judicious use of cost allocation. We are also forced to provide a conceptual
or generic description of circumstance. This we will do, in terms of other
products, other activities, other sources of information and competitors in
the product market, all of which impinge upon the managerial activity at
hand.

This approach also allows us to treat the accounting library as an eco-

\(^4\) So-called DRG (diagnostic related group) categories have been used by Medicare to
set reimbursement schedules. In turn, these prices are informed by product cost calcula-
tions; and negotiations with major commercial insurance carriers are informed by DRG
prices and cost statistics. Hospitals did not install elaborate product costing schemes
until the advent of these cost-based pricing procedures.
The conceptual approach also has its disadvantages. It forces us to mix accounting procedure and circumstance. Accounting procedure by itself could fill several books. It also forces us to think in terms of a small, parsimonious model of accounting and circumstance; otherwise we become overwhelmed with detail. It is also not easy. Studying methods of accounting is an inherently easier task. It is not open ended, and correct answers are readily verified (versus readily constructed).

Our approach, then, is conceptual.\(^5\) This forces us to focus on fundamentals, and offers the prospect of a clarifying perspective. Efficiently dealing with fundamentals, however, leads to a thematic approach that places demands on the reader. It demands patience and it demands tolerance for abstract notation. It also presumes familiarity with financial accounting (e.g., recording of transactions and the accrual process), economics (e.g., allocation of a budget in light of tastes and market prices and the profit maximizing view of firm behavior), and statistics (e.g., probability and regression). We will also make modest use of calculus and optimization and, as noted, abstract notation (in the form of sets and functions).\(^6\)

1.3 Ingredients for an Interesting Stew

That said, this book mixes several essential ingredients to bring out central features of the accounting landscape. A first ingredient is uncertainty. We routinely admit uncertainty. The reason is we want the accounting measurements to tell us something. This implies there is something we don’t know. Not knowing something is modeled as uncertainty. Where possible we will suppress uncertainty, but only to develop our theme as efficiently as possible. For example, uncertainty will not play a major role when we study the manner in which product costs are calculated. Subsequently, when we study how one might extract data from the accounting library to estimate a product cost, uncertainty will play a central role. Otherwise, by definition, we would have nothing to estimate.

\(^5\)The conceptual orientation should be distinguished from a theoretical study. A theoretical study would begin with first principles and deduce various implications, such as the nature of a cost allocation scheme that has significant information content. Theory deals with underlying principles. It informs our study; indeed, references to the theoretical literature are provided at the end of various chapters. But our study is purposely structured to stay between the purely descriptive and the purely theoretical. The purely theoretical is too far removed from practice. The purely descriptive is too ephemeral.

\(^6\)Luddites erroneously believed manufacturing machinery should be destroyed as it led to lower employment. A variation on this erroneous theory is that human capital in the form of economics, statistics, and so on should not be used in the study of accounting. To the contrary, economics, statistics, and so on make our study of accounting more productive and (to my mind) more exciting.
A second ingredient is *other sources of information*. It is important to understand and acknowledge that the accounting system does not have a monopoly on financial measurement or insight. We would not look to Homer for the answer to a mathematical question, just as we would not rely on our physician for insight into the market for satellite mapping services. Equally clear, we wouldn’t look to the accounting system for something more readily available elsewhere. As humorous and as obvious as this appears, there is a deeper side. When multiple sources of information are available, they are often combined in highly unintuitive fashion. This will be particularly significant when we study performance evaluation in the light of various measures of performance.

A third ingredient is *multiple products or services*. A single product firm is just not a useful platform for our purpose. Literally, a single product story means the organization produced so many units of a good or service in a single time period and then closed down. The accounting is too easy. Accruals are irrelevant, as are interdependencies among products.\(^7\)

A fourth ingredient is an assumed *model of behavior*. To put some structure on the idea that a manager is using the accounting measures, we are forced to say something about how the measures are used. For this purpose we will assume the manager is an economic agent. This means the manager's behavior is so consistent it can be described as if the manager had a utility function and selected from among alternatives so as to maximize that utility. Going a step further, we will assume this takes the form of expected utility maximization. This is done because the use of probabilities in the description allows us to say something about how information is used. In turn, this is critical to our venture, since we model accounting as providing information to and about the manager.

This behavior assumption, then, allows us to mix uncertainty, alternate sources of information, and the use of probabilities to govern the processing of information. This is useful and insightful. It is also costly. People are prone to systematic (and not so systematic) violations of the tenets of economic rationality, and we will invoke this at appropriate times in our study. Also, economic rationality is not too friendly to the view that one of the resources provided by accounting is a model of consequence. The economic actor comes ready equipped with a fully developed model of consequence. This schism, too, will be noted at appropriate points in our study.

\(^7\)A personal computer manufactured in one period is a distinct economic product from the same personal computer manufactured in another period. The second exists at a different time, just as the resources used in its production were consumed at a different time. A single product firm has one product, in a single period setting. If we are worried about depreciation, for example, we have multiple time periods and therefore multiple products. This is why the economic theory of the single product firm has nothing to say about depreciation.
On the other hand, economic rationality has its advantages. Economic forces are hardly benign. Using them adds structure to our task; and, as the reader will discover, leads to significant, counterintuitive insights into informed professional use of accounting measurements.

A final assumption, nearly too obvious to mention, is that accounting is not free. If accounting is costly, we should then expect its practice to reflect this fact; we should expect it to be less than perfect. The inevitable tensions between cost and quality should be controlling. Our study will routinely make use of less than perfect accounting measurements. This is reality. Accounting can always be improved, if one is willing to pay the price. Economic forces enter to stop us short of the best that is feasible. We will not explicitly dwell on this theme. It is implicit throughout the study.

1.4 Overview

Our study will focus on the two metaphorical questions of what might it cost and did it cost too much. We do this in four steps. Initially, in Chapters 2 through 7 we study product costing. In Chapters 8 through 12 we study managerial decision making with an emphasis on the "what might it cost" theme. In Chapters 13 through 18 we study managerial performance evaluation, with an emphasis on the "did it cost too much" theme. Chapter 19, the concluding chapter, provides a synthesis.

The pattern in each step along the way is to begin with fundamentals, and then introduce accounting, interpreted as an artful application of the fundamentals. In the product costing arena, then, we begin with the economic theory of the (single product) firm. This is the stepping-off point of our study. Many managerial concepts have their roots in economic theory. What we mean by product cost, for example, is rooted in the economic theory of the firm. Yet the single product orientation blinds us to interactions among products and across periods, so in Chapter 3 we extend the story to a multiproduct firm, where products might coexist in a given period or be phased across periods. Here we encounter an admonition that the only meaningful concept of product cost is marginal cost, an admonition that will guide us throughout our study. Also, as it is commonplace to refer to

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8 Literally, billions are expended each year on accounting for economic activity. Deeper, though, is the other side of the coin. Using accounting is costly. It takes skill, practice, and time. In addition, we humans are not expert at digesting large amounts of unstructured data. Predigested, codified, and summarized presentations are the norm. We should not make the mistake of presuming the best way to deal with accounting information is to collect and display as much as possible. Accounting aggregates data for a variety of reasons, one of which is our inability to process large amounts of data in an unstructured format.
these fundamentals as the theory of the firm, we will throughout our study refer to the organization of concern as a firm. This will serve as a gentle, recurring reminder of our fundamentals.

From here, in Chapter 4, we juxtapose accounting and the economic fundamentals. This portends a continuing theme of less than perfect measurement of economic concepts, thanks to less than perfectly functioning markets. Chapters 5 through 7 then bring the firm’s financial data bank, or accounting library, into focus. Here the emphasis is on product costing. This is an important topic, and it serves as a vehicle to develop the library theme. We emphasize the typical accounting library makes judicious use of three building blocks: aggregation (as too much detail is overwhelming), cost curve approximation (as a more sophisticated cost expression is overbearing), and cost allocation. The same techniques are also used to measure cost incurred in a manager’s department or division. We also emphasize the accountant’s product costing as an artist’s rendering of the fundamentals, moving, historically, from the impressionism school to the modernism school and its emphasis on activity based costing.

We then turn to the second step in our odyssey: managerial decision making, where the same approach emerges. In Chapters 8 through 10 we focus on the fundamentals of economic rationality, decision framing, and choice under uncertainty, followed by strategic choice. We then turn, in Chapters 11 and 12, to artful use of these fundamentals. Inherently small versus large decisions are stressed, where the distinction revolves around whether the decision is largely straightforward or highly nuanced in nature. Underlying these examinations are decision framing techniques that call for various expressions of product cost, our what might it cost theme. The accounting library is routinely helpful in these matters, but extracting its information, its clues, requires an understanding of how the library’s data were put together (the above mentioned building blocks) and the particular decision frame we find comfortable.

This leads to the third step of evaluating the manager. Again we move from fundamentals to the accountant’s palette. In Chapters 13 through 15 we examine a contracting setting where imperfect markets create a pay-for-performance arrangement between the firm and the manager. This, in turns, leads to an interest in what we mean by performance, and structures our theme of did it cost too much. We then turn to the accountant’s rendering in Chapters 16 through 18, moving from single to multiple managers, coordination and divisionalized structures.

Chapter 19, as noted, concludes with an emphasis on synthesis.
1.5 Summary

This book offers an opportunity to study managerial uses of accounting information. Compared with financial accounting, the topic is inward looking; it concerns managerial activities inside the firm. This is more pedagogical than descriptive, however. The firm can hardly survive without paying close attention to capital, labor, and product markets (not to mention governmental activities). The study flows from product costing to decision making to performance evaluation. This flow is designed to assemble all parts of the puzzle in orderly fashion, and to emphasize the two thematic questions of what might it cost and did it cost too much. The risk in the flow is that the parts will be viewed more as separate entities than as building blocks for a more delicate and interacting fabric.

The study is also not separated from the realities of managerial life. We readily assume a setting where multiple goods and services are available. Uncertainty and multiple sources of information are also center pieces of our study. We also assume the professional manager, the user of the accounting information, responds to economic forces in a largely consistent fashion.

Finally, the study is not separated from financial accounting. External and internal reporting activities share the same library. Management’s progress is, in part, judged by its financial reports; and governance of the accounting library is influenced by the regulatory apparatus of financial reporting.

Read on!

1.6 Bibliographic Notes

It seems appropriate to begin with some historical perspective. Luca Pacioli’s *Suma de Arithmetica, Geometria, Proportioni, et Proportionalita*, published in 1494, provided the first systematic description of the practice of double entry record keeping, though accounting per se is much, much older (Basu and Waymire [2006]). Cost accounting is largely the product of the 19th century. For example, E. St. Elmo Lewis’ third edition of *Efficient Cost Keeping*, published in 1914, states the "... first edition ... was issued in 1910 in response to what we believed to be a well-defined interest among businessmen in cost finding." Clark [1923] provided the first comprehensive treatment of costing. Solomons [1968] provides a delightful historical survey, while Cooper and Kaplan [1991] provide a more modern perspective. Also, a helpful resource to keep in mind as we proceed is the two volume handbook edited by Chapman, Hopwood and Shields [2007].
2

Economic Foundations: The Single Product Firm

The purpose of this chapter is to review several important ideas in economics. The firm operates in and is disciplined by markets, so we begin with the economist’s notions of a market and market value. From there we move to the economist’s portrayal of a firm as an institution that straddles factor and output markets. In this view, the firm uses market prices and its production function to decide what to produce and sell, and how to produce what it has chosen to produce. And it is at this point our study begins to take shape. Framing the firm’s choice of output and input into revenue and cost components introduces us to the economic theory of cost. This is the foundation upon which the accountant’s product costing art is built, a foundation that will guide us at every twist and turn of our journey. We extend this review in the next chapter to multiproduct firms.

This material is critical to our development. This is the foundation on which our notions of cost, revenue and income are rooted. You will find the going formal at times, and this is on purpose. Accounting is too important, too useful, and too intellectually fascinating to be shorted due to a shallow understanding of foundations.
2.1 Perfect Markets

A perfect market is a trade mechanism in which some fungible\(^1\) item, such as a beverage, a transportation service, an hour of labor service, or an automobile, is tradable without restriction under known, constant terms of trade. This stylization is deceptively simple. Whatever the item, we know exactly what it is at the time of acquisition. We know the purity of the beverage, the reliability of the transportation service, the skill and motivation with which the hour of labor will be delivered, and the quality of the automobile. We also know the price of the item in question. We can purchase a fractional amount, no transaction costs of any kind are experienced, and no courts are necessary to enforce the terms of trade.

Some abstraction will drive the point home. Suppose trade is calibrated in a common currency, called dollars. Let \(q\) be the quantity of the item in question and \(P\) be the price expressed as dollars per unit. We know \(P\); and \(q\) can be any real number. If \(q > 0\) we pay \(Pq\) and receive \(q\) units. If \(q < 0\), we receive \(-Pq\) (Remember, the negative of a negative is positive!) and deliver \(q\) units. Naturally, we would not arrange to purchase \(q > 0\) units if we did not have \(Pq\) dollars with which to pay the supplier, just as we would not promise to deliver \(q < 0\) units if we did not have (or have access to) these units.\(^2\)

Trade takes place without ambiguity or friction in a perfect market. If we have to ask what the price is, the market is not perfect. If the price per unit depends on how many units are involved, the market is not perfect. If we have to pay a broker to arrange the trade, the market is not perfect.

2.2 The Firm Straddles Markets

The firm now enters the story as an organization that stands between, that straddles, markets. The firm is more efficient than pure market arrangements at organizing production. The university is a ready example. Instead of daily prices for each and every class and graded assignment, we have a collection of policies and conventions, designed by those with decision rights and administered by bureaucrats, that govern such things as course offerings and schedules, degree requirements, and so on. A super market is another example, where we have a huge variety of products acquired, stocked and offered for sale, as opposed to a huge variety of individual vendors with a single spot market for each and every item.

\(^1\)That is, freely exchangeable in whole or in part.
\(^2\)This is one of the fictions of a perfect market. People actually pay their bills. Similarly, if you contract for the cable company to arrive at 10:00 am on Thursday, the technician actually arrives on the promised date at time. Fiction can be appealing.
2.2 The Firm Straddles Markets

We begin, however, with the fiction of a single product firm. This opens the door to our understanding of cost, at minimal complexity. Suppose, then, a firm is equipped to produce some good, say, pencils. Let \( q \geq 0 \) denote the quantity of pencils produced and sold. The quantity produced depends on what resources, called factor inputs, the firm uses and what production technology it possesses. Though factors come in endless variety, we develop the idea with but two, say labor and capital. Denote the two factor inputs by \( z_1 \geq 0 \) and \( z_2 \geq 0 \). (Since they are inputs, we require them to be non-negative, just as the output is required to be non-negative.)

In turn, how inputs can be transformed into outputs is cataloged in the firm’s production function. Denote this function by \( q = f(z_1, z_2) \). If inputs \( z_1 \) and \( z_2 \) are supplied, any output quantity between \( q = 0 \) and a maximum of \( q = f(z_1, z_2) \) can be produced. We should think of the function \( f(z_1, z_2) \) as providing a complete and reliable description of what the firm can produce. The following diagram emerges.

![Diagram](inputs (z_1, z_2) \rightarrow f(z_1, z_2) \rightarrow output q)

We naturally assume no free lunch, in the sense that zero input produces nothing other than zero output: \( 0 = f(0, 0) \).

**Example 2.1** To illustrate, suppose \( f(z_1, z_2) = \sqrt{z_1 z_2} \), again for \( z_1, z_2 \geq 0 \), and also that the technology must maintain \( z_1 \leq 15 \).\(^3\) Thus, to produce, say, \( q = 5 \) units, the feasible possibilities consist of any pair of factors such that \( 5 \leq \sqrt{z_1 z_2} \), or \( 5^2 = 25 \leq z_1 z_2 \) and \( z_1 \leq 15 \). So, for any feasible \( z_1 > 0 \) we require \( z_2 \geq 25/z_1 \).

What output and inputs does the firm choose? Recall that the firm straddles output and input markets; and it pays attention to the prices in those markets. Let \( \hat{P} \) denote the price per unit in the output market, \( P_1 \) the price per unit in the first input market and \( P_2 \) the price per unit in the second input market. All three markets are perfect.\(^4\) The technical possibilities open to the firm are defined by the production function; and the market prices lead the firm to its profit maximizing choice.

Suppose the firm considers a production plan of \( q \) units of output, based on inputs of \( z_1 \) and \( z_2 \). Assume the plan is feasible, with \( q \leq f(z_1, z_2) \). The firm will then receive \( \hat{P}q \) from customers in the product market and will

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\(^3\) Being a function, \( f(z_1, z_2) \) assigns exactly one output quantity \( q \) to a given input list, \( z_1 \geq 0 \) and \( z_2 \geq 0 \). Also, this is an example of a Cobb-Douglas production function. The generalized version in the two factor case takes the form \( q = z_1^\alpha z_2^\beta \) for non-negative exponents and factors of course. Notice the example uses \( \alpha = \beta = \frac{1}{2} \).

\(^4\) This is hardly necessary, but greatly simplifies our task.
pay a total of \( P_1 z_1 + P_2 z_2 \) to suppliers in the two factor markets. Its profit, or income, will be the net of receipts and payments: \( \hat{P} q - P_1 z_1 - P_2 z_2 \). The firm chooses the feasible production plan with the largest profit.

Symbolically, we may describe its behavior as solving the following maximization problem.\(^5\) Notice we denote the maximum profit by \( \Pi(\hat{P}, P) \), where \( P = [P_1, P_2] \) is the listing of factor prices. The firm’s maximum profit depends on the market prices it faces (as well as its presumably fixed technology).

\[
\Pi(\hat{P}, P) \equiv \max_{q \geq 0, z_1 \geq 0, z_2 \geq 0} \hat{P} q - P_1 z_1 - P_2 z_2 \tag{2.1}
\]

s.t. \( q \leq f(z_1, z_2) \)

Viewed in this fashion, the firm possesses some exogenously specified technology that is recorded in its production function. It then takes price signals from the input and output markets and uses these signals to select the best production plan.

**Example 2.2** To put words to this music, return to the above example and assume the selling price is \( \hat{P} = 40 \) while the factor prices are \( P_1 = 5 \) and \( P_2 = 20 \). So we want to maximize \( 40q - 5z_1 - 20z_2 \) subject to (1) \( q \leq \sqrt{z_1 z_2} \) and (2) \( z_1 \leq 15 \), again for \( q \geq 0, z_1 \geq 0, \) and \( z_2 \geq 0 \).We readily find an optimal quantity of \( q = q^* = 15 \), along with respective factor choices of \( z_1^* = 15 \) and \( z_2^* = 15 \). Notice we designate optimal choices with an asterisk (*); this convention will be maintained throughout. The firm earns a profit of \( 40(15) - 5(15) - 20(15) = 225 \).\(^6\)

Two interpretive points will be important in subsequent developments. First, we have confined the exposition to two factors simply to avoid tedium. We should be thinking in terms of a large number of inputs, say \( q = f(z_1, z_2, ..., z_m) \) where \( m \) is a large number. For example, imagine the different inputs in a modestly sized grocery store.

Second, the story we have sketched is a single period story. With more detail we would think in terms of units of output in each period, inputs of various kinds in each period, and profit defined via the present value of the resulting cash flow series. Many, many factors and a multiperiod

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\(^5\)One might ask whether this maximization actually has a solution. Here we sidestep various technical assumptions that would ensure a solution exists. These issues also extend to such niceties as the factors displaying diminishing marginal productivity. Likewise, if the production function is only defined for a given range of inputs, as in the first example, this is understood in our specification.

\(^6\)The easiest way to verify this is indeed the solution is to use the optimization package in, say, Excel. Once you have verified the solution, try it again, but without the \( z_1 \leq 15 \) constraint. What happens? This is why we invoke \( z_1 \leq 15 \). Further notice our little firm earns strictly positive profit, implying it enjoys some type of market power. This particular assumption, of market power, is unnecessary but helps keep us focused on fundamentals.
orientation will turn out to be important elements in understanding the accountant’s work. But that is getting ahead of the story.

A final point here concerns the nature of the maximization problem that we used to depict the firm’s choice of output and inputs in (2.1). The essential ingredients in that exercise are the production function and the market prices. We completely solved the firm’s problem without any reference to cost or revenue. This is an important lesson. Much of the data in any firm’s financial data bank concerns the cost of various activities. It is possible to describe the firm’s behavior economically with no explicit reference to cost. It is also possible to describe the firm’s behavior with explicit reference to its cost. Different ways of framing a choice problem lead to different measures of cost. Cost is not a unique concept, either to the economist or the accountant.

2.3 The Economic Cost Function

To begin developing this theme, stay with the one output, two inputs story in (2.1). Fix the output at some feasible but otherwise arbitrary quantity \( q \). Now define the cost of this output quantity to be the minimum factor payments that must be expended to produce \( q \) in light of the factor prices. Denote this minimum expenditure by \( C(q; P) \) where, again, \( P = [P_1, P_2] \) is the listing of factor prices\(^7\). We have the following construction.

\[
C(q; P) \equiv \min_{z_1 \geq 0, z_2 \geq 0} P_1 z_1 + P_2 z_2 \\
\text{s.t. } q \leq f(z_1, z_2)
\]  

(2.2)

Repeating this process for all possible output quantities gives us a cost function, denoted \( C(q; P) \). Importantly, economic cost is the minimum expenditure on factors that will allow the firm to produce the quantity in question. We carry along the factor prices in the notation to remind ourselves that, in general, the mix of factors used to produce some level of output will depend on the factor prices. Moreover, with the factor prices given, output is the sole explanatory variable of the firm’s cost.

A typical cost function based upon explicit factor prices might appear as displayed in Figure 2.1.\(^8\) Notice that cost is zero when quantity is zero, reflecting our earlier assumption that zero input implies zero output.

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\(^7\) You are probably wondering about the obsessive notation. But it will be important to remind ourselves that the mix of factors depends on their relative prices. Outsourcing is an example.

\(^8\) The noted cost function in Figure 2.1 can be derived from technology and factor price specifications, but with a more complicated technology than presumed in our series of illustrations.