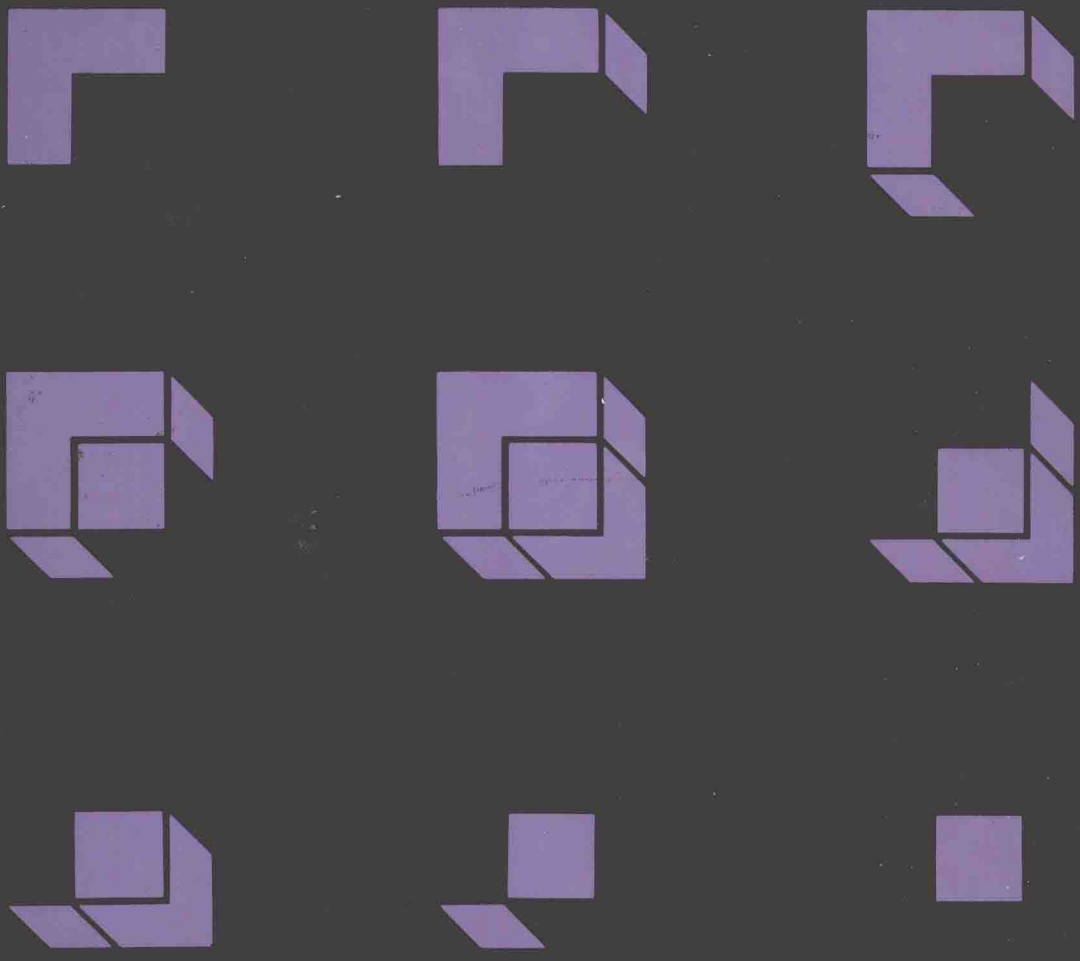
MICRO-ECONOMIC THEORY

P.R.G. LAYARD AND A.A. WALTERS



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MICROECONOMIC THEORY

To Paddie and Pam

PREFACE

This book is based on the final-year graduate course in microeconomics that we have been giving at the London School of Economics. The drafts of the book, including the problems, have been tried out on two vintages of students, who have provided many useful comments. In addition, some students have gone systematically through the material page by page and provided detailed comments on obscurities in the text and in the problems. With their help we have, we hope, improved the clarity of the book. Among our students, we want to thank in particular M. Ahmed, C. Bellringer, M. Farmer, M. Foley, D. Grubb, A. Nisaruddin, P. Read, and D. Stanitsky. D. Grubb contributed substantially to Chapters 5 and 6, while A. Nisaruddin was responsible for checking the whole book and producing the index.

We should also like to thank the publisher's reviewers, M. J. Boskin, R. A. Dulaney, E. Foster, J. M. Henderson, W. L. Holahan, R. E. Quandt, and J. P. Quirk for their helpful and enthusiastic comments. In addition many of our colleagues have generously commented on one or more chapters: P. S. Dasgupta, C. R. S. Dougherty, P. R. Fallon, W. M. Gorman, B. V. Hindley, R. A. Jackman, H. G. Johnson, J. Muellbauer, S. J. Nickell, A. K. Sen, M. A. M. Smith, J. E. Whalley, P. J. Wiles, and B. S. Yamey. We are extremely grateful to them and for the atmosphere in the L. S. E. Economics Department, which makes such things possible. The book was superbly typed by S. Brewer, B. Jory, and P. Mounsey.

As regards our own roles, the structure of the course was designed by Alan Walters, who also prepared an initial set of lecture notes. The book was written by Richard Layard.

P. R. G. Layard
A. A. Walters

INTRODUCTION

Economics is meant to be useful. At any rate, most students hope it will help them to think better about public policy or about business or personal matters. This book tries to meet their needs. We have concentrated on those parts of economic theory which are now regularly used in trying to solve real-world problems. This is no low-brow exercise, for the mark of progress in economics is that so much theory is now used in practical analysis. We have not found any textbook which assembles most of the useful theory together in one place and presents it at a level suitable for regular graduate and advanced undergraduate students. Some primarily mathematical texts do indeed cover much of the theory; but, because they concentrate on formal rigour, students often fail to appreciate the real-world relevance of the ideas. We try to illustrate the many imaginative applications of these ideas, partly by using a more intuitive (though, we intend, correct) style of text and also by including practical exercises with every section.

Exercises

These exercises (labelled **Q1-1**, and so on) are an intrinsic part of the text. The pedagogic reason for them is that students often fail to learn from reading because they are not immediately challenged to test their understanding of what they have read. That is why the exercises come with every section. You should be able to answer most of the unstarred questions on the basis of what you have just read. Outline answers are included at the back and, if you have trouble with many exercises, it suggests you should reread the section. The starred questions are more difficult and invite you to intellectual adventure. But even the unstarred questions are likely to take as much time as reading the text.

Content

So much for the method of the book. Its content is also somewhat novel. Economics consists of *positive* theory (about how the world is) and *normative*

theory (about what should be done). When discussing positive theory, one often wants to allude to its policy implications. So for many purposes it is best to establish the rules of normative analysis first. By treating welfare economics in the first chapter (rather than the last, as is usual), we hope to make explicit the types of value judgment that have to be made before policies can be properly advocated. Most important of all, the discussion of the welfare basis of normative economics provides a strong motivation for the student and a useful frame of reference for much of what follows.

We next proceed, again unusually, to a treatment of general equilibrium (the two-sector model) before we have discussed in detail the behaviour of consumers and producers. This has many advantages. First, it follows naturally from the welfare economics analysis of the optimality or otherwise of the market system. Second, it encourages from the start a real, as opposed to monetary, approach to the concepts of cost and value. Third, it leads naturally to the interesting topics of tax incidence and international trade, which can be treated effectively within the relatively simple framework of the two-sector model. And finally it focuses one's mind on the importance of certain parameters, such as the elasticity of substitution, which are treated more formally later.

However, tackling general equilibrium this early in the book will be unsuitable for some students. It requires tools they will not have, unless they have completed an intermediate course. And some will in any case prefer to start with the more advanced analysis of individual behaviour and leave the question of general equilibrium to the end. The book has therefore been written flexibly so that the chapters can also be read in the order 1, 5–13, 2–4 or in the order 5–13, 1–4.

Chapters 5 and thereafter proceed in a fairly conventional order, taking the different economic agents in turn. First we consider the equilibrium of the consumer, and then we apply utility theory to public pricing policy. Next we examine the producer, and the properties of competitive and uncompetitive markets, mainly for products. Finally, we turn to factor markets, treating first demand and then supply. The book ends by introducing uncertainty and seeing what difference it makes.

The mathematics needed is nothing more than differential calculus (and the elementary idea of an integral). The book has no separate glossary, but we have tried to write it so that the meaning of terms can be easily looked up through the index. We also include a list of further reading. We hope you will enjoy the book.

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Part 4 Production and Factor Demand

Part 5 Factor Supply

Part 6 Uncertainty

PART ONE

WELFARE ECONOMICS AND GENERAL EQUILIBRIUM

CHAPTER

ONE

WELFARE ECONOMICS

Economics is about making the best of things. In other words, it is about choice subject to constraints. The approach is the same whether we are explaining what actually happens in the world or saying what ought to happen. In the first case, which is a matter of "positive" social science, we assume that individuals are consistently pursuing their chosen objectives. From this we predict various features of behaviour. In the second case, which is a "normative" issue, we assume some ethical objective. From this we deduce what ought to be done, given the facts of life. Whichever problem we consider, the formal approach is the same: optimisation subject to constraint.

Most of this book is about positive economics. But, as we explain in the Introduction, one purpose of positive economics is to discover facts relevant to public policy. To draw policy conclusions from these facts, normative theory is needed. So we start by considering normative, or "welfare," economics.

This deals with three main questions. The first is very ambitious and asks: How should a particular society's resources ideally be used, and what social organisation (capitalism, socialism, or whatever) is best for bringing this allocation about? We deal with this major issue in Secs. 1-1 to 1-4. However, in practice, the world is less than ideal. So it is useful to ask a second, less enormous but in many ways more important question: How can we tell whether any change we make is for the better? This is treated in Secs. 1-5 and 1-6. To answer both questions in any specific way, one must of course use some specific ethical welfare function to evaluate the alternatives being compared. So the third issue, discussed in the last section, is: What would be the properties of an acceptable welfare

function? This is ultimately a matter of personal value judgment, since as David Hume pointed out 200 years ago, you cannot get an "ought" from an "is." But the question can still be fruitfully discussed.

1-1 SOCIETY'S ECONOMIC PROBLEM

We begin by examining the ideal configuration of the economy, given any particular welfare function. A society is endowed with resources of all kinds: land, capital, and, above all, the time of its citizens. These can be used in alternative ways to generate benefits for the members of society. Many resources can produce benefits without being used for what is normally called production. For example, people can enjoy spending time in the countryside or any other form of rewarding experience you may care to think of. However, provided we define production in a wide way that does not confine it to what happens in a factory, we can say that resources (or "factors" of production) are always used to produce "products." So the first issue is:

1. How should factors be allocated among products? This will determine both the quantity of each product and the technique by which it is produced, as reflected in its mix of inputs (factors).

But a second question then arises:

2. How should the products be distributed among the different citizens?

Much ink and feeling have been spent on the question of whether these two issues can be treated separately. However, unless special assumptions are made, it is fairly obvious that the two must be solved simultaneously.

This emerges clearly if we set up the problem formally, in order to determine what conditions must be satisfied if an economy is ideally organised. For concreteness we shall assume a very simple closed economy with two people: A (Robinson Crusoe?) and B (Man Friday?). The economy is endowed with two factors, which we shall call capital K and labour time L. This is purely for illustration.† We assume these are available in fixed quantities $\bar{K}$ and $\bar{L}$. (Later in the book we relax the assumption of fixed factor supplies, but it remains true that the ultimate resources of the community, properly defined, are at any one moment given.) Our two factors are homogeneous and perfectly divisible‡ and can be used to produce two equally homogeneous and

† We discuss the problems that arise in the measurement of capital (and labour) in Chapter 12.

‡ A factor or good is homogeneous if all units of it have identical qualities. It is perfectly divisible if it can be divided in any way whatsoever; for example, 1 lb of sugar can be readily divided into ounces or similar units, but this is more difficult to do with cars.

divisible outputs: x (wheat) and y (fish). So if K^x indicates capital allocated to producing x, and so on, the allocation of factors is constrained by

$$\bar{K} = K^x + K^y \qquad \bar{L} = L^x + L^y$$

Once allocated, these factors generate outputs. The production function specifies for each product the maximum output that can be produced with any particular set of inputs. We suppose the production functions of x and y are

$$x = x(K^x, L^x) \qquad y = y(K^y, L^y)$$

where more of any factor leads to more output. These outputs in turn must be allocated between Crusoe and his friend. So, if x^A is the amount of x allocated to A and so on, then

$$x = x^A + x^B \qquad y = y^A + y^B$$

We shall suppose that the happiness of A depends only on how much x and y he gets. If he were altruistic, his happiness would also vary directly with what B got; if he were envious, it would vary inversely with what B got. Adding such interdependences does not alter the basic structure of the problem, but for simplicity we omit them. Thus A has a happiness, or *utility*, function u that tells us how well off he is, depending on his consumption of products x and y; so does B:†

$$u^A = u^A(x^A, y^A) \qquad u^B = u^B(x^B, y^B)$$

Once again more of x or y leads to more happiness.

These remarks define the constraints within which the society operates: factor endowments are limited, technology limits the goods that can be produced by given factors, and tastes limit the happiness that can be produced by given goods. What configuration of the economy is optimal depends on one's personal value judgments, embodied in one's own ethical welfare function. In particular, people differ in the importance that they attach to equality as against efficiency, and this will be reflected in their welfare functions. So, if we follow custom and call this function the *social welfare function*, we are not implying that there is any agreement in society about what is desirable. We shall, however, assume that the only variables that are to count towards welfare are the happinesses of the individuals in society. Apart from this, we need not commit ourselves yet to any exact specification of the function, since mathematics enables us to sit on the fence and simply write the welfare function as $W(u^A, u^B)$. The problem is thus:

$$\max W = W(u^A, u^B)$$

† As we shall show in the last section, it is necessary, for any satisfactory form of normative economics, to assume that the happiness of an individual is a cardinal entity; e.g., if there are three states of the world, it must make sense to say of a given individual that $u^1 - u^2 = u^2 - u^3$, where u^i is utility (or happiness) in state i. For positive economics no such assumption of cardinality is necessary (see Chapter 5).