

Resource Economics

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Edward Arnold

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First published 1984 by
Edward Arnold (Publishers) Ltd.
41 Bedford Square, London WC1B 3DQ

Edward Arnold, 300 North Charles Street, Baltimore, Maryland 21201, USA

Edward Arnold (Australia) Pty Ltd, 80 Waverley Road, Caulfield East, Victoria
3145, Australia

British Library Cataloguing in Publication Data

Norton, G. A.

Resource economics.

I. Microeconomics

I. Title

330 HB171

ISBN 0-7131-3494-1

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Preface

To help set the reader in the right frame of mind in approaching this book, it is important that the purpose for which it was written is appreciated from the outset. *Resource Economics* is an introductory text, intended for those with no previous training in economics. The main ideas of economics are presented in as clear a fashion as possible, using a minimum of mathematical notation and relying heavily on flow diagrams and other graphic means of illustration. The overriding purpose is to provide the reader with a basic understanding of key concepts and tools that will be of value in thinking about and analysing problems of resource management.

The context in which these basic ideas of economics are introduced to the reader is provided by a general model, described in Chapter 1. It relates the production and demand for goods and services to resource use in its widest sense. Focussing on the market component of this model, the next three chapters describe the theories of demand (Chapter 2), production (Chapter 3), and price (Chapter 4). To complete the theoretical section, two chapters, on decision theory (Chapter 5) and welfare theory (Chapter 6), follow. The remaining chapters, which are intended to illustrate the relevance of these economic concepts to specific problem areas, deal with land use (Chapter 7), resource depletion (Chapter 8), pollution (Chapter 9), and environmental impact analysis (Chapter 10).

A familiar convention in economics, used throughout the book, is to ignore many of the complications found in the real world, enabling ideas and concepts to be introduced in the simplest and clearest form possible. Although concessions are subsequently made to reality, either by indicating where practical problems lie or by relaxing major assumptions, the reader will have to look elsewhere for information on empirical studies or for detailed examples of practical applications. The bibliography at the end of the book should provide help in finding suitable sources.

This is only part of the problem however. When attempting to relate abstract economics and the real-world, an equally important problem is the economist's single discipline view of what, in reality, are multi-discipline problems. In recognising this, an attempt is made in *Resource*

Economics to achieve some integration with other disciplines, particularly the life sciences, as will be found in the chapters on decision theory, land use, resource depletion, pollution, and environmental impact analysis. Although much greater integration is still to be achieved, *Resource Economics* will have served its purpose if it introduces the reader to concepts on which a broad and yet rigorous approach to the analysis of resource management problems can be based.

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1984

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Contents

Preface	iii
1 Resources, Wants and Choice	1
2 Demand Theory	8
Household demand	9
Market demand	13
3 Production Theory	20
The production function	22
Resource substitution	26
Production possibility	29
The short-run and the long-run	31
Individual and market supply	35
4 Price Theory	38
A fish market	38
Problems with price theory	44
Domestic water supply in the UK	45
Agricultural policy	48
5 Decision Theory	54
States of nature	54
Available actions	55
Possible outcomes	56
Probability distribution of outcomes	58
Evaluation	60
The problem of oil drilling	69
6 Welfare Theory	73
Welfare economics	73
Cost benefit analysis	80
7 Land Use	89
The market and land use	89
Land use planning	100

8 Resource Depletion	104
Non-renewable resources	108
Renewable resources	114
9 Pollution	122
How pollution arises	122
The optimum level of pollution control	125
Policy instruments for pollution control	129
10 Environmental Impact Analysis	138
The decision analysis approach to EIA	140
Bibliography	151
Index	157

1

Resources, Wants and Choice

Economics is frequently portrayed as the antithesis of environmentalism. It is seen as the root cause of practices that pollute and destroy natural habitats, increasingly leading towards problems of global resource depletion. To suggest that economics has an important, if not a crucial, role to play in the theory and practice of resolving environmental problems therefore, may appear surprising. Yet this is precisely what this book does suggest.

A major cause of confusion concerning the relationship between economics and the environment arises from the dual role that economics is called on to play. First, as a scientific discipline, economics is involved with the construction of theories concerning the way in which the world works. Since these hypotheses can to some extent be tested by observations, this scientific, or positive, role of economics bears many similarities to the natural sciences, both being concerned with an objective search for answers to questions of 'what is...?' or 'what will be...?'

The second role of economics is to provide a basis for decision making. In this normative role, it is concerned with questions of 'what ought to be...?' Since moral or ethical judgments about what is good or bad are necessarily involved however, one obviously cannot appeal to the facts to assess whether normative statements are right or wrong. Agreement with a normative statement rests ultimately on value judgments, on which the economists' opinion is no better than anyone else's.

This distinction can be illustrated with an example from ecology, a discipline that suffers almost as much as economics from confusion over its positive and normative roles. Consider the statement: 'A doubling of trampling pressure caused by visitors to a particular nature reserve will reduce the species diversity of its flora'. Is this positive or normative? Since the validity of this statement can be tested by experimental means, or by monitoring the changes that occur in areas where trampling pressure is increasing, it is clearly positive. Now what about the statement: 'Access to nature reserves should be increased'? In this case, although agreement with the statement, or not, partly depends on positive aspects, such as the estimated impact of increased trampling, the *normative features of the problem are likely to dominate. Whether access to nature reserves should be increased or not will finally depend*

2 *Resources, Wants and Choice*

on such value judgements as those concerning the importance of nature conservation compared with education and recreational enjoyment.

This same example can also be used to illustrate the positive and normative role of economics. Consider the question: 'What will be the effect on visitation of charging an entrance fee for nature reserves of \$2 per person?'. Since an objective answer to this question can be obtained, at least in theory, by appealing to empirical or experimental evidence, the question is clearly positive. Now what if we change the question to 'Should there be an entrance fee of \$2 per person for nature reserves?' Apart from considering the positive ecological and economic elements described above, as well as the operational constraints to what is feasible in practice, an answer to this normative question ultimately requires a value judgement concerning the moral or political principle of charging for public access to nature reserves.

In most of the chapters in this book, the emphasis is on positive economics. However, in later chapters, particularly those on decision theory, welfare economics, and environmental impact analysis, we will discuss means of dealing with normative elements in an objective fashion. In the meantime, since no science is free from moral or value judgements, the reader should be aware that normative elements are likely to be hidden in the remainder of this chapter, and throughout the book!

Having made this distinction, let us now consider what exactly is meant by economics. Most economists would define their discipline as that concerned with 'the study of the allocation of scarce resources for the satisfaction of human wants, and the problems of choice that this involves'. Three key concepts are involved: scarce resources, human wants, and problems of choice.

1 *Scarce resources*

Economists traditionally classify resources into three categories:

- (i) **Natural resources** - consisting in particular of land but including minerals, oil, water, and biological resources.
- (ii) **Labour resources** - involving physical manpower and management expertise.
- (iii) **Capital resources** - including such man-made aids as buildings and machinery, that enhance the productivity of natural resources and labour. An important feature of capital is that it entails sacrifice: money that is saved and invested in physical capital cannot be spent on consumption.

2 *Human wants*

The purpose of allocating resources to various activities is to meet human wants, of which the need for food, shelter and clothing is clearly the most basic. Once these requirements for survival have been met,

other, increasingly non-essential, human wants arise, including those associated with the luxury goods and services that are a feature of affluent societies.

3 The problem of choice

With a given stock of resources, the problem of choice is how to allocate them to the production of goods and services to meet human wants (Fig. 1.1). For this to be an economic problem, two conditions must exist. First, resources must be scarce. Clearly, if there is an unlimited supply of resources, every individual can have as many goods and services as he wishes: there is no allocation problem, and so, by definition, no economic problem. The second condition is that human wants are translated into demand. In economic terms, this only occurs where potential customers have both the ability and willingness to pay for the goods and services they want. Since firms can only be expected to produce goods and services when they receive payment for them, goods

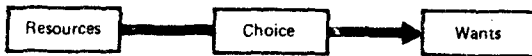


Fig. 1.1 The economic problem - 1

and services must be in demand before production will take place. In many, third world countries, a major constraint to agricultural development is the lack of demand for local, agricultural produce, that arises from extreme and widespread poverty, rather than a shortage of agricultural land, labour, or even capital.

Since resource scarcity, and the problems of choice that result, are common to all societies, principles of economics will also be relevant in these societies. This is true as much for primitive, tribal societies that barter goods and services, as for modern industrial economies, whether they operate under the market system or are centrally planned. Having made this point, we now focus on the 'western' market system, and consider the conventional theory of how this system operates.

To start with, it is assumed that resource owners, producers, and consumers, behave in a way that is economically rational. Resource owners are assumed to maximize their satisfaction by selling their resources to the highest bidder. Producers are assumed to maximize their satisfaction by purchasing those resources, and allocating them to provide those goods and services that will maximize profits. Although exceptions to these assumptions are easy to find, they often provide reasonable, working hypotheses. Finally, with a given budget to spend, consumers are assumed to maximize their satisfaction by the choice of goods and services they make within a given budget. Since tastes are so obviously subjective, it is difficult to refute this assumption.

In the western market system, the institutional link between these three groups of decision makers - resource owners, producers, and consumers - is provided by the market (Fig. 1.2). The sale and purchase of land, labour, and capital, occurs through the resource market, while the product market provides the mechanism for the sale and purchase of goods and services. The feedback mechanism, so critical for the operation of the system, is provided by prices. Thus, as consumers increase their demand for a particular product, and compete for the limited quantity supplied to the market, they will bid up its price. Since this means that the profit for producers of that product is increased, an incentive for allocating more resources to its production will result. In this way, the preferences of consumers, expressed in terms of their willingness to pay for particular goods and services, are relayed through the price mechanism to determine the way in which resources are allocated. In some ways, the consumption behaviour of society can be seen as a vote for a particular form of resource allocation.

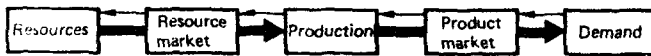


Fig. 1.2 The market system. Flow of material and energy (→)
Flow of money (←)

It is at this point where political economists take the theory into normative realms. Most notably, in the 1770's, Adam Smith suggested that the market mechanism was like an 'invisible hand'. By coordinating the individual actions of producers and consumers, who attempt to follow their own selfish goals of maximizing satisfaction, this 'invisible hand' is seen to achieve an allocation of resources that maximizes the satisfaction, or economic welfare, of society as a whole.

In practice, of course, there are a number of reasons why this is unlikely to be the case. First, since income is unlikely to be distributed equally, resource allocation will be unfairly biased by the greater voting power of the rich. However, as the economist cannot define an optimal distribution of income in a positive sense, it must necessarily remain a normative question. The second difficulty, which is more of a technical one, concerns the factors affecting the smooth running of the market system. The idea of Adam Smith, that the market produces the best allocation of resources from society's point of view, relies on the condition that the market is competitive. Since the market system is driven by selfish motives, a socially optimal outcome will only be produced where this inherent tendency to selfishness is kept in check by fair or perfect competition. If unfair advantages can be obtained, through monopoly or restrictive practices, for example, the allocation mechanism will be distorted and a sub-optimal outcome for society will result.

While these first two problems, of income distribution and imperfect competition, are concerned with biases likely to occur in the market model, the remaining two problems concern the inability of this over-simplified model to represent the total economic welfare of society. To start with, there is the problem of system dynamics. Although the flow of money, from right to left in Fig. 1.2, is shown as just one way, in reality money is returned to households through wages, rent and dividends, and, once taxes and savings are removed, is used again for consumption (Fig. 1.3). Since this circular flow of money links many different activities in an economy, a change in one component of the system can affect a number of other components. For instance, if the demand for a certain good falls, the flow of money to the firm producing that good decreases, production falls, and unemployment results. Since the households of the unemployed will have less money to spend on consumption, the demand for other goods and services will fall, which means that other firms will receive less revenue, and so on. The end result may be that human, natural, and capital resources are under employed, reducing the satisfaction of many sectors throughout the economy.

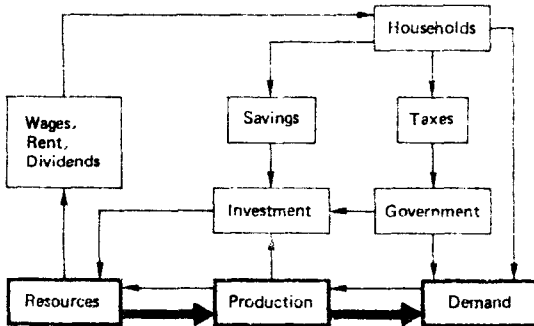


Fig. 1.3 The economic system

Following the experiences of the depression years in the 1930's, and Keynes' interpretation of the system effect, governments have intervened in the market system with the aim of preventing such a failure of the invisible hand. The risk here is that such intervention can lead to inflation. By increasing the money supply to stimulate demand and reduce unemployment, production may not respond fast enough to meet increased demand and, as a result, prices increase, wage demands increase, and an inflationary spiral results.

The remaining problem associated with the over-simplified market model, concerns the way in which resources are seen to affect society's

welfare. In the market model, natural resources, along with labour and capital, are simply inputs to production processes that eventually give rise to the goods and services sold on the market. While consumers can, in effect, 'vote' for the welfare these particular goods and services give them, by spending money to purchase them, the fact that many natural resources have a more direct effect on the welfare of society, by providing the environment in which we live, work, and recreate, does not seem to be accounted for. Despite some reflection in the market mechanism, through house prices and fees for private golf clubs, for example, in many instances this certainly is the case.

The market model also appears to ignore the fact that natural resources often act as receivers of waste material. Just as the flow of money through the economy, from consumers to resource owners, is completed by the payment of wages, rents, and dividends (Fig. 1.3), so the flow of material and energy, involved in producing goods and services, is completed by waste disposal. In short, production and consumption give rise to problems of residual discharge (Fig. 1.4). Since the service provided by natural resources in receiving these wastes is not bought or sold on the market, the costs to society, in the form of

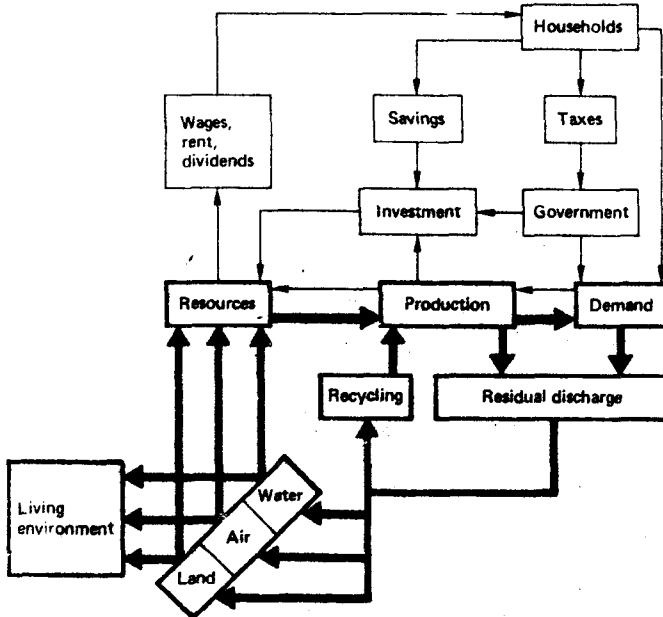


Fig. 1.4 The economic problem - 2. Solid arrows (→) indicate flows of material and energy, line arrows (→) indicate the flow of money.

pollution damage, are incurred outside the market system. It is for this reason that economists, rather perversely perhaps, call such non-market effects 'externalities'.

It can be seen from Fig. 1.4 that the incidence of these pollution externalities will depend, at least in part, on the level and form of activity in the economy. This, in turn, will depend on the size of the population, its affluence and consumption preferences, on the type of technology employed, and on the form that government intervention takes, in terms of economic, technological, and environmental policy. Further, since the flow rate of materials and energy also affects the rate of resource depletion, current economic activity will influence future welfare, as well as the present balance between economic and environmental welfare.

It was on this subject, and the conflict between economic goals, the environment and resource depletion, that we began this chapter. Hopefully, the reader will now see that questions concerning the best balance between these three are normative, each of us having our own views on what this best balance should be. The remainder of this book, in describing the basic concepts of resource economics, aims to provide a better understanding of the more positive factors involved in the system portrayed in Fig. 1.4. The next three chapters concentrate on the market system.

2

Demand Theory

We have already seen in Chapter 1 that serious theoretical and practical short-comings are likely to affect the ability of the market mechanism alone to achieve an allocation of resources that is socially optimal. However, as an explanatory model of how resources are allocated in practice, the theory of the market does provide a most powerful and important statement. Indeed, it forms the cornerstone of economic theory. As well as helping us to understand the problems of choice that face producers and consumers, market theory also goes a long way toward predicting their behaviour. In addition, as we will see later, this theory provides a basis for the social accounting technique of cost benefit analysis. Before looking in detail at demand theory therefore, let us first consider how the market mechanism operates.

The Market Mechanism

Consider a product market, where cabbage growers cut and transport cabbages to a vegetable market each week, for consumers to purchase. The total supply and demand for cabbages, at different prices, is shown in Fig. 2.1. As price increases the demand for cabbages falls off as some consumers buy less cabbage and others are unwilling to pay that price for cabbage at all. Cabbage growers, on the other hand, make more profit as price increases. Their response is to increase supply as price goes up.

To see how these two processes interact, assume that Q_1 cabbages are supplied to the market. Following the vertical line from Q_1 in Fig. 2.1, we can see that the market will bear a price of P_1 : that is, there are just enough consumers willing to pay P_1 for all of Q_1 to be sold, without leaving a surplus. This would not be the case if a higher price than P_1 were charged. Therefore, a market price of P_1 can be expected. Since this price gives what many growers regard as a good return, more cabbages will be cut in the following week. From Fig. 2.1 we see that Q_2 cabbages will be supplied to the market if the expected price is P_1 . However, we have already seen that only Q_1 cabbages will be sold if price P_1 is charged. If Q_2 cabbages are to be cleared, the price will have to be reduced to P_2 (Fig. 2.1). At this expected price, supply falls to Q_3 in the following week, and so on.

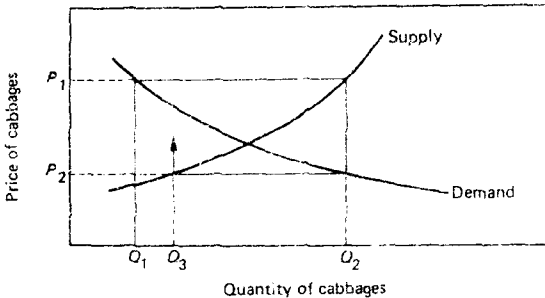


Fig. 2.1 Supply and demand for cabbages

In responding to price in this way, the behaviour of producers and consumers tends to result in movement along the supply and demand curves, towards the point where supply and demand are equated. It is in this sense that price acts as a critical feedback mechanism, regulating supply and demand to produce this equilibrium condition. Our main concern in this chapter is with the theory that lies behind the response to demand. In Chapter 3 we look at the theory of supply, and in Chapter 4 bring demand and supply together again, for a more detailed investigation of the market principle.

Household Demand

To begin our study of demand, we start with the household as the basic consuming unit. Household demand, which is the bundle of goods and services a household purchases, is determined by four factors: goods and services available, preferences, prices and income. To illustrate how these factors interact, let us consider a particular problem of choice.

The Indifference Surface

For the sake of simplicity, assume that only two consumption items are of concern, eating out at a steak house and eating out at a Chinese restaurant. At present, the household we are considering visits a steak house and a Chinese restaurant an equal number of times: on average three times a month. If for some reason it becomes impossible to visit the Chinese restaurant more than twice a month, we may ask the question – how many more times a month would the household need to eat at the steak house to obtain the same level of satisfaction? Put another way, what will be the new combination of visiting the Chinese restaurant, fixed at twice a month, and visiting the steak house, that will make the household indifferent between this combination and the original one: that is, point X in Fig. 2.2?

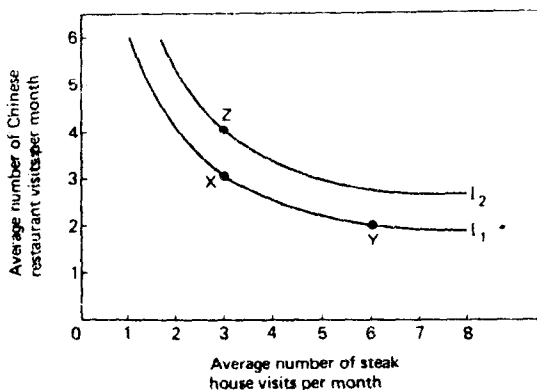


Fig. 2.2 An indifference curve

Clearly, if the household is particularly fond of Chinese food, it will require a large increase in the number of visits to the steak house to compensate for the loss of one Chinese restaurant visit. This is the case shown in Fig. 2.2, where visits to the steak house have to be increased to six times per month to compensate for the lost Chinese restaurant visit: the household is indifferent between combinations Y and X. Repeating this exercise for other steak house-Chinese restaurant combinations, a whole series of points of indifference to X, and now Y, can be derived, giving the indifference curve I_1 shown in Fig. 2.2. All the points on this curve indicate those combinations that give the same level of satisfaction.

Now consider a different situation, where the original eating-out pattern of three Chinese and three steak house visits per month (X) is changed by increasing the number of Chinese restaurant visits to four per month. This new situation, Z in Fig. 2.2, must surely increase satisfaction to a new level; the household is by no means indifferent to this change. Also, a whole series of new indifference points can be identified, depending on the household's preferences for different combinations of restaurant visits compared to Z. Thus, a second indifference curve I_2 is produced, passing through Z, and representing a higher level of satisfaction than that represented by the curve I_1 . Ultimately, a whole series of indifference curves could be identified, producing a contour map of satisfaction for all steak house-Chinese restaurant combinations.

The purpose of this exercise has been to show how a household's preferences for different combinations of services can be represented in the form of an indifference surface, where the contours, or indifference curves, represent the same level of satisfaction. If Fig. 2.2 were redrawn, using another household with different preferences, indifference curve