

Cambridge University Press  
978-0-521-34801-0 - Foundations of Public Economics  
David A. Starrett  
Frontmatter  
[More information](#)

---

## **Foundations of public economics**

Cambridge University Press  
978-0-521-34801-0 - Foundations of Public Economics  
David A. Starrett  
Frontmatter  
[More information](#)

## CAMBRIDGE ECONOMIC HANDBOOKS

*Editor:*

Hugo Sonnenschein  
Department of Economics, Princeton University

*Previous editors:*

J. M. Keynes (Lord Keynes)  
D. H. Robertson (Sir Dennis Robertson)  
C. W. Guillebaud  
Milton Friedman  
F. H. Hahn

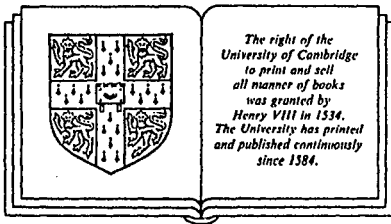
*Other books in the series*

*Peter T. Bauer and Basil S. Yamey:* The economics of underdeveloped countries  
*Roy F. Harrod:* International economics  
*Hubert Henderson:* Supply and demand  
*R. C. O. Matthews:* The business cycle  
*D. H. Robertson:* Money  
*E. A. G. Robinson:* The structure of competitive industry  
*Albert Rees:* The economics of trade unions  
*Ian Bowen:* Population  
*U. K. Hicks:* Public finance  
*E. A. G. Robinson:* Monopoly  
*S. J. Nickell:* Investment decisions of firms  
*G. M. Heal and P. S. Dasgupta:* Economic theory and exhaustible resources  
*A. K. Dixit and V. Norman:* The theory of international trade  
*Douglas Gale:* Money: in equilibrium  
*Douglas Gale:* Money: in disequilibrium  
*D. H. Robertson and E. Dennison:* Control of industry  
*Ruth Cohen:* Agriculture  
*M. R. Bonavia:* The economics of transport  
*Maurice Dobb:* Wages  
*Walter Hagenbuch:* Social economics  
*J. Stiglitz:* The economics of uncertainty  
*D. Newbery:* External economies and diseconomies

Cambridge University Press  
978-0-521-34801-0 - Foundations of Public Economics  
David A. Starrett  
Frontmatter  
[More information](#)

# Foundations of public economics

DAVID A. STARRETT  
*Stanford University*



CAMBRIDGE UNIVERSITY PRESS  
*Cambridge*  
*New York Port Chester Melbourne Sydney*

Cambridge University Press  
978-0-521-34801-0 - Foundations of Public Economics  
David A. Starrett  
Frontmatter  
[More information](#)

---

Published by the Press Syndicate of the University of Cambridge  
The Pitt Building, Trumpington Street, Cambridge CB2 1RP  
40 West 20th Street, New York, NY 10011-4211, USA  
10 Stamford Road, Oakleigh, Victoria 3166, Australia

© Cambridge University Press 1988

First published 1988  
Reprinted 1989, 1991

*Library of Congress Cataloging-in-Publication Data*

Starrett, David A.  
Foundations of public economics / David A. Starrett.  
p. cm. - (Cambridge economic handbooks)  
Bibliography: p.  
Includes index.  
1. Finance, Public. 2. Welfare economics. I. Title.  
II. Series  
HJ141 .S66 1988 87-27892  
336 - dc19  
ISBN 0-521-34256-2 hardback  
ISBN 0-521-34801-3 paperback

*British Library Cataloguing in Publication Data*

Starrett, David A.  
Foundations of public economics.  
1. Finance, public  
I. Title.  
336 HJ141  
ISBN 0-521-34256-2 hardback  
ISBN 0-521-34801-3 paperback

Transferred to digital printing 2001

Cambridge University Press  
978-0-521-34801-0 - Foundations of Public Economics  
David A. Starrett  
Frontmatter  
[More information](#)

---

*To my father*

## Contents

<i>Preface and acknowledgments</i>	<i>page xi</i>
<i>Notation</i>	<i>xii</i>

### **PART I: Scope and limitations**

1	Introduction	3
2	Social objectives and direct decision making	8
	2.1 Interpersonal comparisons	11
	2.2 Majority voting	15
	2.3 Bowen model	18
	2.4 Political decentralization	20
3	Market decentralization	25
	3.1 Command economy	26
	3.2 General Lagrangian procedure and the envelope theorem	31
	3.3 Market decentralization	33
	3.4 Extensions to an intertemporal context with uncertainty	36
4	Theory of collective goods	40
	4.1 Typology of collective goods	42
	4.2 Efficient allocation of a collective consumption good	44
	4.3 Classical theory of clubs	47
	4.4 Heterogeneous clubs	52
	4.5 Persistent scale economies in club size	55
	4.6 Spatial clubs	58

### **PART II: Decision making in a mixed economy**

5	Planning mechanisms	65
	5.1 Extended market procedures for nonexcludable goods	65
	5.2 Problem of the common	73
	5.3 Tiebout-type models of club decentralization	77
	5.4 Decentralizing spatial clubs: Henry George theorem	83
	5.5 General mechanism design	85

viii	<b>Contents</b>	
6	Models of a mixed economy	90
6.1	Static model	91
6.2	Intertemporal considerations	95
6.3	Uncertainty and missing markets	100
7	Government budgeting and fiscal decentralization	104
7.1	Unified government budget	105
7.2	Impact of intergenerational (and other) governmental transfers	109
7.3	Capital account for government	112
7.4	Problems in budget coordination	113
7.5	Fiscal federalism	115
8	Public pricing and optimal-commodity taxation	120
8.1	Optimal public pricing	120
8.2	Diamond–Mirrlees optimal-commodity-tax framework	124
8.3	Full-commodity-tax discretion	128
8.4	Limitations on tax discretion	133
8.5	Broadly based taxes	135
8.6	Practical problems with uniform tax systems	140
8.7	Distributional concerns	141
<b>PART III: First-order project analysis</b>		
9	Decompositions and general theory of second best	145
9.1	Diamond–Mirrlees framework	146
9.2	Intermediate-goods taxation and quantity constraints	151
9.3	Nonlinear taxes	156
9.4	Practical rules and pitfalls of benefit–cost analysis	158
10	Principles of shadow pricing	161
10.1	Categories of shadow prices	162
10.2	Formulas based on second-best decomposition	164
10.3	Case of tradeable goods	167
10.4	Formulas based on optimal taxation	168
10.5	General expressions for marginal cost of government spending	172
11	Local public goods	175
11.1	Direct taxation	176
11.2	Local commodity taxes	184
11.3	Biases in club choice	186

<b>Contents</b>	<b>ix</b>
12 Intertemporal contexts with uncertainty	191
12.1 Temporal rate of discount	191
12.2 Uncertainty: bare-bones model	195
12.3 Risk premiums in the Diamond–Dreze model	198
12.4 Model with full sequential structure	203
12.5 Project analysis with uncertainty and incomplete markets	210
13 Identifying shadow values: hedonic methods and capitalization	212
13.1 Identification based on spanning	213
13.2 Identification with similar agents	216
13.3 Relationships between hedonic methods and capitalization	218
13.4 Internal capitalization	219
13.5 External capitalization	225
13.6 Comparison and perspective on capitalization measures	227
 <b>PART IV: Evaluating large projects</b>	
14 Search for exact measures	233
14.1 Marginal analysis in presence of nonconvexity	234
14.2 Compensating variation in a market context	236
14.3 Measures for a mixed economy	243
14.4 Uncertainty and expected surplus	244
15 Surplus approximations	246
15.1 Second-order approximations of individual utility	247
15.2 Aggregation of second-order measures	249
15.3 Second-order measures for a mixed economy	253
15.4 Upper and lower bounds	254
15.5 Direct use of naive surplus	258
16 Practical methods for large-project evaluation	260
16.1 Recovering willingness to pay for collective goods	261
16.2 Parametric econometric identification	264
16.3 Groves–Clarke mechanism	268
16.4 Commonly used framework	272
16.5 Project interactions and concept of alternative cost	273
17 Peak-load problem	277
17.1 General welfare problem	278



Cambridge University Press  
978-0-521-34801-0 - Foundations of Public Economics  
David A. Starrett  
Frontmatter  
[More information](#)

---

x	<b>Contents</b>	
	17.2 Peak-load phase	280
	17.3 Optimal capacity for single project	283
	17.4 Optimal timing of recursive investments	285
	<i>Epilog</i>	293
	<i>References</i>	294
	<i>Author index</i>	307
	<i>Subject index</i>	310

## Preface and acknowledgments

This book is an attempt to present a variety of important ideas from welfare economics and public finance in a coherent framework and to integrate my own recent research agenda into this framework. Although I hope the book will be suitable for use in graduate level courses, I have not tried to be either fully self-contained or completely comprehensive. Rather, I have tried to give a unified treatment of the main themes in applied welfare economics as I see them; further, I have assumed that the reader is familiar with material covered in a standard first-year microeconomics sequence (roughly at the level of Edmond Malinvaud's *Lectures on Microeconomic Theory* and Hal Varian's *Microeconomic Analysis*) and with the associated mathematical techniques of constrained optimization (as expounded in Michael Intriligator's *Mathematical Optimization and Economic Theory*). Although I have made no conscious effort to differentiate my product from other available sources, I think the reader will find more emphasis here on the expenditure side of public finance than in Anthony Atkinson and Joseph Stiglitz (*Lectures on Public Economics*) and more emphasis on local public issues than in Richard Tresch's *Public Finance: A Normative Theory*.

Many people have given me help in preparing this manuscript. In particular, Thomas Downes, Suzanne Scotchmer, David Wildasin, and several anonymous reviewers have read parts or all of it and provided useful comments. I should also thank classes of students who were subjected to early versions of the manuscript; I hope the final copy is improved as a result of their experience. There probably never would have been a manuscript at all were it not for the Center for Advanced Study in the Behavioral Sciences at Stanford, which provided me with exactly the kind of uninterrupted time necessary for such an endeavor. Further, the manuscript never would have been revised without the efforts of Michael Spence, whose software package *Technical Formatting Program* greatly facilitated the seemingly endless sequence of changes and corrections. Finally, I hope the reader will be able to see the influence of my mentor, Kenneth Arrow. It is no accident that his name is prominent in my reference list – his ideas lie behind many of the topics I discuss.

## Notation

Most of the analysis of this book is conducted in a framework where the number of goods, households, clubs, and so on, is arbitrary. Consequently, it is very convenient to employ matrix notation and make full use of the associated vector calculus. Notation can be simplified further if we agree at the outset to certain conventions on vector orientations.

Prices (and “shadow” prices) will be assigned a natural orientation as row vectors, whereas quantities inherit a natural orientation as column vectors. On the rare occasions when we need to change the orientation, transposes will be indicated using curly brackets:  $\{ \}$ . Thus, if  $P$  is a (row) vector of goods prices,  $\{P\}$  is the corresponding column vector. These orientations will extend to functions as well. Thus, if  $C(P)$  represents a demand system, it is thought of as a *column vector function*. Correspondingly, if  $P(g)$  represents equilibrium prices as functions (say) of levels of public goods provided, it is to be thought of as a row vector function.

Variable subscripts always stand for a matrix index and whenever they are absent, we think of the variable as a vector (or matrix) over the associated index (or indices). Thus,  $P_i$  is the price of the  $i$ th good. Superscripts stand for matrix labels and will rarely, if ever, be treated as indices of some larger “supermatrix.” For example,  $c^h$  represents the consumption vector of household  $h$ . We will use lowercase letters to represent consumption and production flow variables of *individual economic agents*, reserving the corresponding uppercase variables for economywide aggregates. Thus,  $C$  is aggregate consumption ( $C = \sum_h c^h$ ). Individual stock variables will have capital letters; for example,  $B$  is consumer financial wealth.

When we need to refer to the number of elements in a vector, we do so using the symbol  $|\cdot|$  (here, the centerdot is a universal variable). Thus,  $|C|$  refers to the number of consumption goods.

We will use the gradient symbol  $(\nabla_x)$  to indicate partial derivatives with respect to a vector  $x$ . Again, we require some conventions with respect to orientation. Suppose we have a scalar function  $f$  of a vector  $x$ . Then the vector of partial derivatives will be denoted  $\nabla_x f$ . It will have the orientation of a column vector if  $x$  is a row vector and vice versa. For example, if  $\Gamma(g)$  represents a cost function for producing a public-goods (column)

vector  $g$ , then  $\nabla_g \Gamma$  represents a *row* vector of marginal costs. (Note: frequently we suppress arguments of functions when the meaning is clear.)

Gradients of vector functions naturally form matrices, which will be oriented as follows. Suppose we have a column vector function  $C(b)$ , where  $b$  is a vector of *any* orientation. Then  $\nabla_b C$  is the matrix

$$\nabla_b C = \begin{bmatrix} \partial C_1 / \partial b_1 & \cdots & \partial C_1 / \partial b_{|b|} \\ \partial C_2 / \partial b_1 & \cdots & \partial C_2 / \partial b_{|b|} \\ \vdots & & \vdots \\ \partial C_{|C|} / \partial b_1 & \cdots & \partial C_{|C|} / \partial b_{|b|} \end{bmatrix}.$$

Observe that orientation has been fixed so that each column corresponds to a partial derivative of the column vector with respect to one argument, and the number of columns equals the cardinality of  $b$ . Similarly, we orient the gradient of a row vector function so that each row corresponds to a partial derivative of the row vector.

Note that this last set of rules fails to specify an orientation for the gradient of a scalar function, so we still need the earlier rule specified for that case.

The conventions outlined so far are designed to simplify specific representations encountered in this book. However, they are generally consistent with common practice in a wider arena. Of course, we can apply these rules in series to construct matrices of second- (and higher) order partial derivatives. For example, the Hessian matrix for a scalar function  $f(x)$  would be denoted:  $\nabla_{x,x}^2 f$  (and similarly for other matrices of second partials).

The inner product of matrices  $x$  and  $y$  will be written simply as  $xy$ . Naturally, the matrices must be compatible ( $x$  has the same number of columns as  $y$  has rows). Thus, if we want to express the inner product of price vector  $P$  with itself, we must write  $P\{P\}$  (not  $PP$ ). At a number of points that follow, we will encounter quadratic (and other bilinear) forms, and although all of these can be expressed in terms of the notation developed so far, it is convenient to introduce a separate notation. For example, suppose we encounter a quadratic form involving row vector  $t$  and compatible square matrix  $x$ ; we could always write it as  $tx\{t\}$ , but instead we choose to express it as  $\langle t, x, t \rangle$ . More generally,  $\langle s, x, t \rangle$  refers to a bilinear form where  $s$  has the orientation of a row vector (regardless of its natural orientation),  $t$  the orientation of a column vector, and  $x$  a matrix of compatible dimensions.

Extensive use will be made of Kuhn–Tucker–Lagrange methods for non-linear programming. Except where otherwise stated, we will assume all functions are differentiable at least to second order and will work with

xiv      **Notation**

first- and second-order conditions for optimality. Also, in the interests of notational economy, we will assume interior solutions whenever they seem natural; the reader is invited to replace equalities with the appropriate inequalities and complementary slackness conditions if boundary solutions are contemplated.

Because we want to use the simplest possible inner-product notation, names for variables and parameters must be single letters (otherwise, multiple letters have potentially ambiguous meaning). Even using all uppercase and lowercase Greek and Latin letters, this set of potential names is too small. Hence, we are forced to make two types of compromises.

First, a few letters will have dual meanings. The lists of symbols that follow give a dictionary of meanings with alternative meanings in parentheses. Note that most duplications involve the spatial model on the one hand and the temporal model with uncertainty on the other (these models will never be considered jointly). For example, the letter  $s$  is a time index in the latter model whereas it represents a location index in the former; similarly,  $r$  represents land rental rates in the spatial model and interest rates in the temporal model.

Second, a few names will be assigned using multiple (uppercase) letters. This will be done only when the associated variables rarely appear in algebraic expressions and have natural meanings as acronyms or words. Thus, for example, VAR and COV are the variance and covariance functions, and RP represents risk premium and TT terms-of-trade effect.

## Notation

xv

### *List of symbols: Latin letters*

---



---

<p><i>a</i> generic decision variable (Chapter 12, asset holdings)</p> <p><i>b</i> government private net inputs</p> <p><i>c</i> net individual consumption</p> <p><i>d</i> asset dividends</p> <p><i>e</i> exponential symbol</p> <p><i>f</i> production functions</p> <p><i>g</i> collective-goods levels</p> <p><i>h</i> household index</p> <p><i>i</i> generic index</p> <p><i>j</i> firm index</p> <p><i>k</i> project capacity (local public finance, index of “active” community)</p> <p><i>ℓ</i> land holdings</p> <p><i>m</i> income levels</p> <p><i>n</i> population sizes</p> <p><i>o</i> status quo reference</p> <p><i>p</i> market parameters</p> <p><i>q</i> strategies in mechanisms</p> <p><i>r</i> interest rates (land rental rates)</p> <p><i>s</i> time index (spatial location)</p> <p><i>t</i> tax rates</p> <p><i>u</i> mechanism outcome function</p> <p><i>v</i> asset prices</p> <p><i>w</i> gradient of welfare function</p> <p><i>x</i> variable of integration (planning, social state)</p> <p><i>y</i> private net outputs</p> <p><i>z</i> exogenous resources</p>	<p><i>A</i> firm debt</p> <p><i>B</i> bequests, household wealth</p> <p><i>C</i> aggregate net consumption</p> <p><i>D</i> government debt</p> <p><i>E</i> expectations operator</p> <p><i>F</i> generic function symbol</p> <p><i>G</i> congestion levels</p> <p><i>H</i> household type</p> <p><i>I</i> income compensation function</p> <p><i>J</i> firm type</p> <p><i>K</i> capital stock (size of common)</p> <p><i>L</i> aggregate land (Lagrangian functions)</p> <p><i>M</i> firm equity</p> <p><i>N</i> population aggregates (Chapter 7, government effective deficit)</p> <p><i>O</i> international prices</p> <p><i>P</i> consumer prices</p> <p><i>Q</i> producer prices</p> <p><i>R</i> individual orderings (aggregate land rents)</p> <p><i>S</i> time horizon (Chapter 12, risk-sharing transfers)</p> <p><i>T</i> “direct” taxes</p> <p><i>U</i> direct utility functions</p> <p><i>V</i> indirect utility functions</p> <p><i>W</i> social welfare function</p> <p><i>X</i> Cartesian product (set of social states)</p> <p><i>Y</i> aggregate net output</p> <p><i>Z</i> indirect welfare function</p>
---	---

---



---

xvi      **Notation**

*List of symbols: Greek letters*

---



---

$\alpha$	project parameter		
$\beta$	welfare weight		
$\gamma$	utility/cost parameters	$\Gamma$	costs and cost functions
$\delta$	Taylor's series symbol	$\Delta$	discrete increment
$\partial$	partial derivative symbol		
$\epsilon$	elasticities (regression residual)		
$\xi$	growth rates (Chapter 9, LM for quantity constraints)		
$\eta$	private activity levels		
$\psi$	pseudoprice of Arrow securities	$\Psi$	capital funds
$\kappa$	various constants		
$\lambda$	LM for income	$\Lambda$	tax distortion vector
$\mu$	LM for government budget		
$\phi$	transport cost	$\Phi$	aggregate transport
$\nu$	LM for profits		
$\pi$	firm profits	$\Pi$	aggregate profits
$\rho$	discount factors		
$\sigma$	town boundary	$\Sigma$	summation symbol
$\tau$	tax function parameters		
$\chi$	cost and type shares		
$\theta$	compensating variation	$\Theta$	naive consumer surplus
$\omega$	state of the world	$\Omega$	shadow values of collective goods
$\zeta$	depreciation rates		

---



---

*Note:* Abbreviation LM means Lagrange multiplier.