This highly original book develops a systematic zero-net-profit comparative statics theory of the firm that challenges many widely held views in microeconomics. It builds a bridge between the marginalist long-run theory of the firm and Sraffian theory to create a unified theoretical framework that explains how firms react to exogenous shocks resulting in new equilibrium positions of the whole economy. The central message of the book is that too often economists expect more from the microeconomic laws of input demand and output supply than they can really give. The authors show that the zero-net-profit condition requires a more articulated analysis that sometimes yields qualitative results contrary to those of familiar economic laws. Written for academic researchers and graduate students, the book will be of particular interest to those working on the microeconomics of industry equilibrium, comparative statics and Sraffian economics.

Arrigo Opocher is Full Professor of Economics at the University of Padua. He has published in leading economics journals on the topics of economic theory and its history and has written books on long-run growth and trade theory. He is co-editor of the journal *Metroeconomica*.

Ian Steedman is Emeritus Professor of Economics at Manchester Metropolitan University. He is the (co-)author or editor of 14 books and over 140 articles. Until his retirement he was very active in editorial work for the *Cambridge Journal of Economics*, the *European Journal of the History of Economic Thought* and *Metroeconomica*.

Full Industry Equilibrium
Full Industry Equilibrium

A Theory of the Industrial Long Run

ARRIGO OPOCHER AND IAN STEEDMAN
Full Industry Equilibrium: A Theory of the Industrial Long Run
Arrigo Opocher and Ian Steedman

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2015

A catalogue record for this publication is available from the British Library

To
Antonella
and
Xiaoling
# Contents

<table>
<thead>
<tr>
<th>List of figures</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of tables</td>
<td>xiii</td>
</tr>
<tr>
<td>Preface</td>
<td>xv</td>
</tr>
</tbody>
</table>

## Introduction
- An outline of the book
- 1 Taking seriously the tendency to zero net profits
  - 1.1 The long-run theory of the firm, the industry and the economy
  - 1.2 The long-period theory of production, the industry and the firm
  - 1.3 Full industry equilibrium
  - 1.4 Comparing full industry equilibria
  - 1.5 Concluding remarks

## 1 An isolated industry
- 2.1 Full industry equilibrium
- 2.2 An example
- 2.3 The comparative statics of FIE
- 2.4 On the relationship between input use and input price
- 2.5 On a supposed relationship between long-run output and price
- 2.6 Produced input use. A very simple case
- 2.7 A falling real price of computing power. The role of complementarity
- 2.8 Beyond twice-differentiable average cost functions. On/off inputs
- 2.9 Concluding remarks

## Appendix 1
- A1.1 Input substitution in *Value and Capital* and beyond
- A1.2 Hicksian substitution and on/off inputs
Contents

Appendix 2 A small open economy
A2.1 The standard HOS model as an example of FIE
A2.2 Trade and industry-specific factors
A2.3 The HOS model with intermediate products
A2.4 Conclusion

3* Multiproduct firms
3.1 FIE with many outputs and one input
3.2 The comparative statics of FIE
3.3 FIE with many outputs and many inputs
3.4 The comparative statics of FIE. The general case
3.5 Alternative concepts of substitution. A general formulation
3.6 Concluding remarks

4 Interdependent industries
4.1 The FIE input prices with interdependent industries: an introduction
4.2 The FIE input price frontier
4.3 The comparative statics of FIE
4.4 An example
4.5* More general
4.6 Introducing a positive rate of interest
4.7 A one-industry economy once again
4.8 Two industries
4.9* Many industries with CES cost functions
4.10 Concluding remarks

5 Industry-level input use. Some aftershocks from capital theory
5.1 Labour and capital per unit of output in a particular industry
5.2 The direct use of primary inputs in a particular industry; previous literature
5.3 A Wicksellian two-period case
5.4 A Nuti-model case
5.5 The corn-tractor (Samuelson–Surrogate) case
5.6 An input–output case
5.7 Recurrence of the complete input–output matrix
5.8 Concluding remarks
## Contents

6 The ‘autonomous’ components of input prices  
   6.1 Real cost reduction in an isolated industry  
   6.2 Real cost reduction with interdependent industries  
   6.3 Real cost reduction and TFP  
   6.4 Concluding remarks  

7 The effects of taxation  
   7.1 An isolated industry  
   7.2 Two industries  
      7.2.1 A tax on one commodity  
      7.2.2 A tax on all commodities  
   7.3 Many industries  
   7.4 The effects of taxation on input use per unit of output  
   7.5 Concluding remarks  

8 Productivity increase  
   8.1 An isolated industry  
   8.2 Many industries  
   8.3 Many industries with input–output relations  
   8.4 Intermediate inputs, price accounting and TFP  
   8.5 Assessing productivity increase by price accounting: some historical notes  
   8.6 Concluding remarks  

9 Full industry equilibrium in retrospect  
   9.1 The theory of multi-input demand in the formative period  
      9.1.1 R.G.D. Allen and the theory of derived demand  
      9.1.2 J.L. Mosak and the theory of the competitive firm  
      9.1.3 J.R. Hicks: the contribution of *Value and Capital*  
      9.1.4 The standardization of the theory of production: P.A. Samuelson  
   9.2 Input complementarity, ‘nearly constant’ returns to scale and regression  
      9.2.1 Complementarity and ‘nearly constant’ returns to scale  
      9.2.2 Regression  
   9.3 ‘Input demand’ under industry equilibrium  
   9.4 Industrial interdependence in the traditional theory of supply  

© in this web service Cambridge University Press  
www.cambridge.org
<table>
<thead>
<tr>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 The role of common factors</td>
</tr>
<tr>
<td>9.6 Supply curves, relative prices and the numéraire</td>
</tr>
<tr>
<td>9.7 Sraffian interdependence(s)</td>
</tr>
<tr>
<td>9.8 Concluding remarks</td>
</tr>
<tr>
<td>10 Conclusions</td>
</tr>
<tr>
<td>References</td>
</tr>
<tr>
<td>Index</td>
</tr>
</tbody>
</table>
Figures

2.1 The real input price curve.  
2.2 Two alternative FIE outputs.  
2.3 The real wage–real rent frontier in an open economy.  
2.4 The real wage–real rent frontier and the Stolper–Samuelson theorem.  
2.5 The real wage–real rent frontier with industry-specific kinds of land.  
2.6 The real wage–real rent frontier and the Stolper–Samuelson theorem with intermediate inputs.  
3.1 Revenue per unit of input and marginal revenue (for small variations in input use).  
3.2 The real output price curve; first case.  
3.3 Output possibility curves conditional on FIE input use; first case.  
3.4 The real output price curve; second case.  
3.5 Output possibility curves conditional on FIE input use; second case.  
4.1 The FIE input prices under the non-substitution theorem.  
4.2 The FIE real wage–real rent frontier, \( \omega \rho \).  
5.1 An ‘extended’ real wage–interest rate curve.  
5.2 Two methods in industry \( n \).  
5.3 Recurrence of type of intermediate.  
5.4 Wage–rent–interest rate relations with each machine type (thick lines for machine 1).  
5.5 Unconventional input use/input price relationships in an input–output model.  
6.1 Real cost reduction in discrete time.  
6.2 Real cost reduction with interdependent industries.  
7.1 Incidence in a simple one-industry, two-primary-inputs model.  
7.2 Incidence with a commodity input.
List of figures

7.3 Incidence in terms of taxed or untaxed commodities. 137
7.4 Incidence of a VAT on industry 1. 139
7.5 Incidence of a uniform sales tax. 141
8.1 The measure of productivity increase, in discrete time. 154
## Tables

2.1 Input use per unit of output with on/off inputs.  
5.1a Two methods, fixed coefficients: individual industries.  
5.1b Two methods, fixed coefficients: whole economy.  
5.2 Infinitely many methods.  
5.3 Smooth substitutability between land and labour in one method.  
5.4 A Nuti-model with equal proportions.  
5.5 A Nuti-model with equal proportions and recurrence.  
5.6 A Samuelson–Surrogate case with labour and land.  
5.7 An input–output example with two techniques.  
5.8 Recurrence of the complete input–output matrix.  
7.1 Two fixed-coefficient techniques.  
8.1 Price developments of wages, raw cotton, twist and plain cottons, 1820–49.  

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Input use per unit of output with on/off inputs.</td>
<td>48</td>
</tr>
<tr>
<td>5.1a</td>
<td>Two methods, fixed coefficients: individual industries.</td>
<td>106</td>
</tr>
<tr>
<td>5.1b</td>
<td>Two methods, fixed coefficients: whole economy.</td>
<td>106</td>
</tr>
<tr>
<td>5.2</td>
<td>Infinitely many methods.</td>
<td>107</td>
</tr>
<tr>
<td>5.3</td>
<td>Smooth substitutability between land and labour in one method.</td>
<td>108</td>
</tr>
<tr>
<td>5.4</td>
<td>A Nuti-model with equal proportions.</td>
<td>110</td>
</tr>
<tr>
<td>5.5</td>
<td>A Nuti-model with equal proportions and recurrence.</td>
<td>111</td>
</tr>
<tr>
<td>5.6</td>
<td>A Samuelson–Surrogate case with labour and land.</td>
<td>112</td>
</tr>
<tr>
<td>5.7</td>
<td>An input–output example with two techniques.</td>
<td>116</td>
</tr>
<tr>
<td>5.8</td>
<td>Recurrence of the complete input–output matrix.</td>
<td>117</td>
</tr>
<tr>
<td>7.1</td>
<td>Two fixed-coefficient techniques.</td>
<td>145</td>
</tr>
<tr>
<td>8.1</td>
<td>Price developments of wages, raw cotton, twist and plain cottons, 1820–49.</td>
<td>165</td>
</tr>
</tbody>
</table>
Preface

The late 1960s saw the growth of the new long-run theory of the firm, many of the contributions to this literature appearing in the *American Economic Review*. At about the same time, capital theory flourished, as a sequel to Sraffa’s famous book, *Production of Commodities*. Each of these theories emphasized that the forces of free competition lead to positions of zero extra-profit and each, in its own way, involved a rejection of over-partial reasoning. At the heart of the new long-run theory of the firm lies the idea that if a zero extra-profit equilibrium is disrupted by, say, an increase in the price of one factor, that price increase must be compensated by an increased product price if such an equilibrium is to be restored. (See, for example, Ferguson and Saving, 1969; Silberberg, 1974; Braulke, 1987.) This need to change more than one price at a time is the very basis of the revised comparative statics. It was also central to Sraffa’s arguments, focused on the economy as a whole, that between any two alternative positions of the economy, corresponding to a different real wage, all relative prices would be different.

However, this common emphasis on changing relative prices in a way consistent with maintaining zero extra profits did not lead to any interactions between the two theories. The present authors, having made some contributions to each of these theories, came to think that both theories could benefit from recognizing the other. This book is our attempt at a systematic discussion of the implications of such a mutual recognition, built upon the central concept of full industry equilibrium (the term is adapted from Wicksell’s *Lectures*, Vol. 1).

Any attempt to build a bridge between two different theories stemming from different traditions is liable to encounter terminological challenges (if no others!). For example, contributors to the new long-run theory of the firm tend to speak of long-run equilibrium, while contributors to Sraffian theory generally speak of long-period positions. Similarly, while the former would tend to refer to a rate of interest and
to extra profits (as we have done above), the latter would usually refer to a uniform rate of profit. Because this book is focused on the theory of both the firm and the industry, it has seemed advisable to follow the more conventional terminology of long-run equilibrium. For the same reason, we refer throughout to free competition, not perfect competition. As to the second distinction, we shall always use the term zero net profit. In the matter of expositional style, we have leaned toward simplicity rather than generality. One whole chapter and two other chapter sections which are perhaps either somewhat more demanding or unnecessary for later arguments are therefore marked with asterisks; some readers may wish to skim or even skip this material on a first reading.

In Sections 4.9 and 5.5 we have drawn on material previously published in *Metroeconomica* in 2013. We benefited greatly from the opportunity to present a short course of lectures on our subject matter to graduate-level students and staff at the Joseph Schumpeter Centre, University of Graz, in October 2011. The writing of this book took a big step forward after these lectures and we thank all the participants for their stimulating questions and suggestions. We are most grateful to Heinz Kurz, both for inviting us to lecture in Graz and for his extensive comments on various versions of the book, and to Edwin Burmeister, Geoff Harcourt and Neri Salvadori for their useful comments on some selected chapters.

A.O. and I.S.