TURNPIKE OPTIMALITY IN INPUT–OUTPUT SYSTEMS

Theory and Application for Planning

JINKICHI TSUKUI

and

YASUSUKE MURAKAMI

1979

NORTH-HOLLAND PUBLISHING COMPANY
AMSTERDAM · NEW YORK · OXFORD

Contents

Introduction to the series v

Preface vii

Chapter 1: Final-state turnpike theory 1
1.1. The scope of the book – need for planning tools 1
1.2. Planning model for capital accumulation 6
1.3. Existence of the turnpike 8
1.4. Possible path and optimal path 11
1.5. Weak turnpike theorem 13
1.6. Strong turnpike theorem 18
1.7. Dual turnpike theorem 20
1.8. Synthesis of the turnpike theorem and its dual 23

Chapter 2: Consumption turnpike theory 25
2.1. Optimal consumption 25
2.2. Planning model for consumption maximization 26
2.3. Optimal stationary states 28
2.4. Consumption turnpike theorem 32
2.5. Weak turnpike theorem 40
2.6. Strong turnpike theorem 45

Chapter 3: Relative stability 49
3.1. Leontief trajectory and relative stability 49
3.2. Forward lag and backward lag 56
3.3. Existence of balanced growth in extended models 59
3.4. Appendix: stability analysis in some special cases 66

Chapter 4: Model for optimal accumulation 75
4.1. Optimal accumulation and the turnpike 75
4.2. Programming model 75
4.3. Data and computation 79

4.4. Theoretical analysis of the computational results 86
4.5. Comparison of actual and computed values 93

Chapter 5: Nonlinear turnpike model 95
5.1. Nonlinear function and stock adjustment activities 95
5.2. Nonlinear model and bent turnpike 96
5.3. Computational method 100
5.4. Data and computation 102
5.5. The property of the solution 104
5.6. Appendix: smoothing output adjustment by changing the utilization level of capital 108

Chapter 6: Model for optimal technological change 111
6.1. Technological change 111
6.2. Model for technological change and optimal path 112
6.3. Data and computation 118
6.4. Economic interpretations of the optimal solution 121

Chapter 7: Consumption turnpike models 129
7.1. Utility function and time discount rate 129
7.2. Consumption maximization model and its turnpike 132
7.3. Data and computation 135
7.4. The property of the solution 137
7.5. The solution under concavity 139

Chapter 8: International trade in turnpike models 159
8.1. Models when export markets are infinitely elastic 159
8.2. Model when export markets are rigidly given 164
8.3. Data preparation 165
8.4. Optimal level of exports 167
8.5. Optimal export pattern 174
8.6. Trade and optimal consumption 180
8.7. Appendix: two-country turnpike model 183

Chapter 9: Model for prevention of pollution 189
9.1. Basic model 189
9.2. Generation of pollution and its elimination 192
9.3. Model including pollution elimination 194
9.4. Preparation of data and computation of model 196

9.5. Comparison and evaluation of computational results 213
9.6. Appendix 216

References 253

Index 257