

Contents

List of Figures	<i>page</i> xiii
List of Tables	xvi
Foreword by Luis F. López Calva and Robert Axtell	xvii
Acknowledgements	xxiii
List of Abbreviations	xxv
PART I A COMPLEXITY APPROACH TO SUSTAINABLE DEVELOPMENT	
1 Introduction	3
1.1 Motivation for This Book	3
1.2 Cutting-Edge Methods for Challenging Goals	6
1.3 The ‘Policy Priority Inference’ Research Programme	9
1.4 Target Audience	14
1.5 Structure of the Book	16
2 Policy Prioritisation, Complexity, and Agent Computing	22
2.1 Modelling the Expenditure–Development Link	24
2.2 Generative Causation and Social Mechanisms	30
2.3 On Causal Inference and Agent Computing	34
2.3.1 The Identification of Counterfactuals	36
2.3.2 The Workings of the Dependency and Generative Accounts	38
2.3.3 The Validity of Agent-Computing Counterfactuals	43
2.3.4 The Benefits of Using Agent Computing for Policy Evaluations	47
2.4 Summary and Conclusions	51

viii CONTENTS

3	Relevant Data and Empirical Challenges	53
3.1	A Worldwide Look at Sustainable Development through Data	54
3.1.1	SDGs and Indicators	54
3.1.2	Pre-processing Indicators and Descriptive Statistics	62
3.1.3	Countries and Government Spending	68
3.2	Popular Modelling Frameworks and Their Limitations	84
3.2.1	Benchmark Analysis	85
3.2.2	Regression Analysis	86
3.2.3	General Equilibrium Models	88
3.2.4	System Dynamics	91
3.2.5	Network Analysis	92
3.3	Empirical Challenges	95
3.3.1	Adapting to Coarse-Grained Indicators	95
3.3.2	Moving beyond Associations	96
3.3.3	Handling Complex Expenditure Linkages	97
3.3.4	Embedding Vertical Mechanisms	99
3.3.5	Estimating Interdependency Networks	101
3.4	Summary and Conclusions	102
4	A Computational Model	104
4.1	Policy Instruments	105
4.2	Indicator Dynamics	107
4.3	Public Servants	110
4.4	Central Authority	117
4.5	Development Outcomes	122
4.6	Summary and Conclusions	126
5	Calibration and Validation	129
5.1	Calibration Strategy	130
5.2	Optimisation Algorithm	132
5.3	Goodness of Fit	137
5.4	On Statistical Confidence and Testing	139

5.4.1	Confidence Intervals	140
5.4.2	Hypothesis Testing	142
5.5	Validation	144
5.5.1	External Validation	144
5.5.2	Internal Validation	147
5.5.3	Soft Validation	150
5.5.4	Stakeholder Validation	151
5.6	Statistical Behaviour	152
5.6.1	Testing for Synthetic Counterfactuals	153
5.6.2	Parameter Recovery	154
5.6.3	Overfitting	158
5.6.4	Time Equivalence	160
5.7	On Interdependency Networks	160
5.8	Summary and Conclusions	163
PART II A GLOBAL VIEW OF SUSTAINABLE DEVELOPMENT		
6	The Feasibility of the Sustainable Development Goals	167
6.1	On Quantifying the Feasibility of the SDGs	167
6.2	Simulation Strategy	169
6.3	Expected Gaps	171
6.3.1	Gap Closures	176
6.4	Sensitivity to the Budget Size	181
6.4.1	Proportional Changes in the Budget	184
6.5	Summary and Conclusions	185
7	Government Spending and Structural Bottlenecks	188
7.1	On the Concept of a Structural Bottleneck	189
7.1.1	A Formalisation: The Budgetary Frontier	190
7.2	Simulation Strategy	192
7.3	Results	192
7.3.1	Insensitivity on the Budgetary Frontier	192
7.3.2	Poor Performance + Insensitivity = Bottleneck	195

X CONTENTS

7.3.3	Not All Bottlenecks Are Created Equal: A Flagging System	200
7.4	Summary and Conclusions	205
8	Public Governance and Sustainable Development	207
8.1	On the Study of Corruption and the Rule of Law	209
8.1.1	Two Conceptual Frameworks: Principal–Agent <i>versus</i> Systems Thinking	209
8.1.2	The Dominant Empirical Approach: Econometrics	210
8.2	Data with an Endogenous Rule of Law	214
8.3	Simulation Strategy	216
8.4	Results of Counterfactual Analyses	219
8.4.1	Non-linear Responses to Expenditure in the Rule of Law	219
8.4.2	Rugged Policy Landscapes	223
8.5	Summary and Conclusions	228
9	The Impact of International Aid	231
9.1	Studies on Aid Effectiveness	233
9.2	Data	236
9.2.1	Countries and Indicators	236
9.2.2	Government Expenditure	237
9.2.3	Aid Flows	240
9.3	Simulation Strategy	242
9.3.1	Expenditure, Aid, and Counterfactuals	243
9.3.2	Impact Metric	244
9.3.3	Statistical Significance	248
9.4	Results	250
9.5	Beyond Conventional Methodologies	256
9.6	Summary and Conclusions	258

PART III A FOCALISED VIEW OF SUSTAINABLE DEVELOPMENT	
10	Subnational Development and Fiscal Federalism 265
10.1	On Fiscal Federalism 267
10.1.1	Fiscal Decentralisation in Mexico 268
10.2	Data 271
10.2.1	Development Indicators 271
10.2.2	Development Clusters 271
10.2.3	Expenditure Data 277
10.3	Simulation Strategy 278
10.4	Results 282
10.4.1	The Impact of Contributions 282
10.4.2	Optimising Contributions 282
10.4.3	Policy Priorities and Contributions 285
10.5	Summary and Conclusions 287
11	Accelerators and Systemic Bottlenecks 289
11.1	Accelerators, Bottlenecks, and Their Empirical Quantification 291
11.2	Data 293
11.2.1	Government Expenditure 293
11.2.2	Development Indicators 294
11.3	Simulation Strategy 295
11.3.1	Counterfactual Budgets 310
11.3.2	Detection of Bottlenecks and Accelerators 311
11.4	Results 313
11.4.1	Identification of Systemic Bottlenecks and Accelerators 313
11.4.2	Comparison against Naïve Approaches 315
11.4.3	Disaggregation of Systemic Bottlenecks and Accelerators 319
11.5	Summary and Conclusions 321

xii CONTENTS

12	Deprivation, Income Shocks, and Remittances	323
12.1	Socioeconomic Deprivation in the Mexican Context	324
12.1.1	The Importance of Remittances and Research Design	325
12.2	Data	327
12.2.1	Indicators	329
12.2.2	Social Expenditure	333
12.2.3	Household Spending and Remittances	335
12.2.4	The Complex Structure of Government Spending and Development	336
12.3	Simulation Strategy	337
12.4	Results	340
12.4.1	Impact Evaluation by Expenditure Source	340
12.4.2	Shock Mitigation via Government Expenditure	346
12.5	Summary and Conclusions	348
13	Lessons and Reflections	350
13.1	Lessons Learnt	350
13.2	From Analysis to Policy Guidelines	357
13.2.1	Workflow for Strategic Planning	359
13.3	A Call for Computational Social Scientists	362
13.3.1	Necessary Infrastructure	363
13.3.2	Upgrading Skills in Technical Teams	365
13.3.3	Updating Social Science Programmes	366
	Bibliography	370
	Index	390