

Open Economy Macroeconomics

Martín Uribe

Stephanie Schmitt-Grohé

PRINCETON UNIVERSITY PRESS • PRINCETON AND OXFORD

Contents

Preface xvii

1 Business-Cycle Facts Around the World 1

- 1.1 Measuring Business Cycles 1
- 1.2 Business-Cycle Facts Around the World 4
- 1.3 Business Cycles in Poor, Emerging, and Rich Countries 7
- 1.4 Country Size and Observed Business Cycles 9
- 1.5 Hodrick-Prescott (HP) Filtering 11
- 1.6 Growth Rates 14
- 1.7 Business-Cycle Facts with Quarterly Data 17
- 1.8 Duration and Amplitude of Business Cycles in Emerging and Developed Countries 20
- 1.9 Appendix 21
 - 1.9.1 Countries with at Least 30 Years of Annual Data 21
 - 1.9.2 Derivation of the HP Filter 21
 - 1.9.3 Country-by-Country Business-Cycle Statistics at Annual and Quarterly Frequency 22
- 1.10 Exercises 25

2 An Open Endowment Economy 26

- 2.1 The Model Economy 26
- 2.2 Stationary Income Shocks 32
- 2.3 Stationary Income Shocks: AR(2) Processes 35
- 2.4 Nonstationary Income Shocks 38
- 2.5 Testing the Intertemporal Approach to the Current Account 43
- 2.6 Exercises 45

3 An Open Economy with Capital 57

- 3.1 The Basic Framework 57
- 3.2 A Steady-State Equilibrium 60
- 3.3 Adjustment to a Permanent Productivity Shock 60
- 3.4 Adjustment to Temporary Productivity Shocks 64
- 3.5 Capital Adjustment Costs 65
 - 3.5.1 Dynamics of the Capital Stock 67
 - 3.5.2 A Permanent Technology Shock 69
- 3.6 Exercises 69

4 The Open Economy Real-Business-Cycle Model 73

- 4.1 The Model 73
 - 4.1.1 Inducing Stationarity: External Debt-Elastic Interest Rate (EDEIR) 76
 - 4.1.2 Equilibrium 76
- 4.2 Decentralization 77
 - 4.2.1 Households in the Decentralized Economy 77
 - 4.2.2 Firms Producing Final Goods 78
 - 4.2.3 Firms Producing Capital Goods 79
 - 4.2.4 The Decentralized Equilibrium 79
- 4.3 Functional Forms 80
- 4.4 Deterministic Steady State 81
- 4.5 Calibration 83
- 4.6 Approximating Equilibrium Dynamics 85
- 4.7 The Performance of the Model 88
- 4.8 The Role of Persistence and Capital Adjustment Costs 91
- 4.9 The Complete Asset Markets (CAM) Model 92
 - 4.9.1 What Is the Current Account When Markets Are Complete? 96
 - 4.9.2 Quantitative Predictions of the CAM Model 97
- 4.10 Alternative Ways to Induce Stationarity 98
 - 4.10.1 The Internal Debt-Elastic Interest Rate (IDEIR) Model 99
 - 4.10.2 The Portfolio Adjustment Cost (PAC) Model 100
 - 4.10.3 The External Discount Factor (EDF) Model 102
 - 4.10.4 The Internal Discount Factor (IDF) Model 104
 - 4.10.5 The Model with No Stationarity-Inducing Features (NSIF) 105
- 4.11 The Perpetual-Youth (PY) Model 106
 - 4.11.1 Basic Intuition 106

4.11.2	Perpetually Young Households	107
4.11.3	Firms Producing Consumption Goods	110
4.11.4	Firms Producing Capital Goods	110
4.11.5	Equilibrium	111
4.12	Inducing Stationarity: Quantitative Comparison of Alternative Methods	112
4.13	Global Solution	114
4.14	Appendix	119
4.14.1	First-Order Accurate Approximations to Dynamic General Equilibrium Models	119
4.14.2	Local Existence and Uniqueness of Equilibrium	121
4.14.3	Computing Second Moments	124
4.14.4	Computing Impulse Response Functions	126
4.14.5	Matlab Code for Linear Perturbation Methods	127
4.15	Exercises	127
5	Business Cycles in Emerging Countries: Productivity Shocks versus Financial Frictions	140
<hr/>		
5.1	Can the Open Economy RBC Model Generate Excess Consumption Volatility?	140
5.2	An Open Economy RBC Model with Stationary and Nonstationary Technology Shocks	143
5.3	Letting Technology Shocks Compete with Other Shocks and Frictions	149
5.3.1	Households	149
5.3.2	Firms with Working-Capital Constraints	151
5.3.3	Interest-Rate Shocks	153
5.3.4	Equilibrium	154
5.4	Bayesian Estimation on a Century of Data	155
5.5	How Important Are Trend Shocks?	158
5.6	The Role of Financial Frictions	160
5.7	Imperfect Information and Noise Shocks	164
5.7.1	Using the Kalman Filter to Compute Future Expected TFP Growth	169
5.7.2	Computation and Estimation	170
5.7.3	Incomplete Information Versus Noisy Information	172
5.7.4	Estimation and Model Fit	173
5.7.5	The Importance of Noise Shocks	175
5.7.6	How Important Are Nonstationary Productivity Shocks?	178
5.8	Exercises	180

6 Interest-Rate Shocks 186

- 6.1 An Empirical Model 188
- 6.2 Impulse Response Functions 189
- 6.3 Variance Decompositions 196
- 6.4 An Open Economy Subject to Interest-Rate Shocks 199
 - 6.4.1 Firms and Working-Capital Constraints 200
 - 6.4.2 Capital Accumulation and Gestation Lags 201
 - 6.4.3 Households and Habit Formation 202
 - 6.4.4 Driving Forces 204
 - 6.4.5 Equilibrium 205
 - 6.4.6 Estimation by Limited Information Methods 205
- 6.5 Theoretical and Estimated Impulse Responses 207
- 6.6 Theoretical and Estimated Conditional Volatilities 207
- 6.7 Global Risk Factors and Business Cycles in Emerging Economies 209
- 6.8 Exercises 211

7 Importable Goods, Exportable Goods, and the Terms of Trade 216

- 7.1 A Simple Empirical Model of the Terms of Trade 217
- 7.2 The Terms of Trade and the Trade Balance: Empirics 219
- 7.3 Terms of Trade and the Trade Balance: Simple Explanations, Old and New 222
 - 7.3.1 The Harberger-Laursen-Metzler Effect 223
 - 7.3.2 The Obstfeld-Razin-Svensson Effect 225
 - 7.3.3 Testing for the ORS Effect 226
 - 7.3.4 The ORS Effect in the SOE-RBC Model 226
- 7.4 How Important Are Terms-of-Trade Shocks? 229
- 7.5 The MX Model 234
 - 7.5.1 Households 234
 - 7.5.2 Production of Final Goods 236
 - 7.5.3 Production of Importable and Exportable Goods 236
 - 7.5.4 Equilibrium 237
 - 7.5.5 Observables 238
- 7.6 Parameterization of the MX Model 239
 - 7.6.1 Preferences and Technologies in the MX Model 239
 - 7.6.2 Calibration of the Elasticity of Substitution between Importables and Exportables, μ 241
 - 7.6.3 Calibration of the Share Parameter, χ 241

7.6.4	Calibration of the Share of Exports of Value-Added in GDP, s_x	242
7.6.5	Calibration of the Share of Exportable Output in GDP, s_{yx}	244
7.6.6	Estimation of the Capital Adjustment Cost Parameters, ϕ_m and ϕ_x , and the Debt Elasticity of the Interest Rate, ψ	245
7.7	Response of the MX Model to Terms-of-Trade Shocks	247
7.8	Terms-of-Trade Shocks: Less Important in Data Than in Theory	249
7.8.1	Sensitivity Analysis	250
7.9	Exercises	253
8	Nontradable Goods and the Real Exchange Rate	256
8.1	The Real Exchange Rate	257
8.2	The TNT Model	257
8.2.1	The Real Exchange Rate and the Relative Price of Nontradables	259
8.2.2	The Equilibrium Real Exchange Rate	260
8.2.3	Adjustment of the Real Exchange Rate to Terms-of-Trade Shocks	261
8.2.4	Adjustment of the Real Exchange Rate to Interest-Rate Shocks	262
8.2.5	Adjustment of Output to Terms-of-Trade Shocks in the TNT Model	263
8.3	Empirical Evidence on the Effects of Terms-of-Trade Shocks on the Real Exchange Rate and Aggregate Activity	265
8.4	The MXN Model	269
8.4.1	Households	269
8.4.2	Firms Producing Final Goods	271
8.4.3	Firms Producing the Tradable Composite Good	271
8.4.4	Firms Producing Importable, Exportable, and Nontradable Goods	272
8.4.5	Market Clearing	272
8.4.6	Competitive Equilibrium	273
8.4.7	Observables	274
8.4.8	Functional Forms	274
8.4.9	Calibration of the MXN Model	275
8.5	Response of the Real Exchange Rate and Real Activity to Terms-of-Trade Shocks in the MXN Model	279
8.6	The Terms-of-Trade Disconnect	282
8.7	Exercises	286
9	Nominal Rigidity, Exchange Rates, and Unemployment	290
9.1	An Open Economy with Downward Nominal Wage Rigidity	290
9.1.1	Households	291
9.1.2	Firms	293

9.1.3	Downward Nominal Wage Rigidity and the Labor Market	295
9.1.4	Equilibrium	295
9.2	Currency Pegs	297
9.2.1	A Peg-Induced Externality	299
9.2.2	Volatility and Average Unemployment	300
9.2.3	Adjustment to a Temporary Fall in the Interest Rate	302
9.3	Optimal Exchange-Rate Policy	306
9.3.1	The Full-Employment Exchange-Rate Policy	306
9.3.2	Pareto Optimality of the Full-Employment Exchange-Rate Policy	308
9.3.3	When Is It Inevitable to Devalue?	309
9.4	Empirical Evidence on Downward Nominal Wage Rigidity	310
9.4.1	Evidence from Micro Data	310
9.4.2	Evidence from Informal Labor Markets	312
9.4.3	Evidence from the Great Depression of 1929	313
9.4.4	Evidence from Emerging Countries and Inference on γ	314
9.5	The Case of Equal Intra- and Intertemporal Elasticities of Substitution	316
9.6	Approximating Equilibrium Dynamics	318
9.7	Parameterization of the Model	319
9.7.1	Estimation of the Exogenous Driving Process	319
9.7.2	Calibration of Preferences, Technologies, and Nominal Rigidities	321
9.8	External Crises and Exchange-Rate Policy: A Quantitative Analysis	323
9.8.1	Definition of an External Crisis	323
9.8.2	Crisis Dynamics under a Currency Peg	324
9.8.3	Crisis Dynamics under Optimal Exchange-Rate Policy	326
9.8.4	Devaluations, Revaluations, and Inflation in Reality	328
9.9	Empirical Evidence on the Expansionary Effects of Devaluations	328
9.9.1	Exiting a Currency Peg: Argentina Post Convertibility	329
9.9.2	Exiting the Gold Standard: Europe 1929–1935	330
9.10	The Welfare Costs of Currency Pegs	330
9.11	Symmetric Wage Rigidity	336
9.12	The Mussa Puzzle	337
9.13	Endogenous Labor Supply	339
9.14	Production in the Traded Sector	341
9.15	Product Price Rigidity	343
9.15.1	Downward Price Rigidity	343
9.15.2	Symmetric Price Rigidity	345
9.16	Staggered Price Setting: The Calvo Model	346
9.16.1	Households	346
9.16.2	Firms Producing Final Nontraded Goods	348

9.16.3	Firms Producing Nontraded Intermediate Goods	348
9.16.4	Aggregation and Equilibrium	350
9.16.5	The Flexible-Price Equilibrium	355
9.16.6	Optimal Exchange-Rate Policy	356
9.16.7	The Open Economy New-Keynesian Phillips Curve	356
9.16.8	Crisis Dynamics in the Calvo Model	358
9.16.9	Welfare Costs of Currency Pegs in the Calvo Model	362
9.17	Exercises	365
10	Exchange-Rate Policy and Capital Controls	369
<hr/>		
10.1	First-Best Fiscal Policy under Fixed Exchange Rates	369
10.1.1	Labor Subsidies	369
10.1.2	Equivalence of Labor Subsidies and Devaluations	372
10.1.3	Sales Subsidies	374
10.1.4	Consumption Subsidies	374
10.2	Capital Controls	375
10.2.1	Capital Controls as a Distortion of the Interest Rate	378
10.2.2	Equilibrium under Capital Controls and a Currency Peg	379
10.3	Optimal Capital Controls under Fixed Exchange Rates	380
10.4	The Optimality of Prudential Capital Control Policy	381
10.5	Optimal Capital Controls during a Boom-Bust Episode	385
10.6	Level and Volatility Effects of Optimal Capital Controls under a Currency Peg	386
10.7	Overborrowing under Fixed Exchange Rates	389
10.8	The Welfare Cost of Free Capital Mobility in Fixed Exchange-Rate Economies	390
10.9	Are Observed Capital Controls Prudential?	392
10.10	Appendix: Equilibrium for $t \geq 1$ in Section 10.4	395
10.11	Exercises	397
11	Policy Credibility and Balance-of-Payments Crises	399
<hr/>		
11.1	The Model	400
11.1.1	Households	400
11.1.2	The Government	401
11.1.3	Equilibrium	402
11.2	A Credible Tax Reform	403
11.3	A Noncredible Tax Reform	403
11.3.1	Lack of Credibility and Overborrowing	406
11.3.2	Equivalence of Imperfect Credibility and Temporariness	407

11.4	Lack of Credibility and Exchange-Rate Policy	408
11.4.1	A Cash-in-Advance Economy	410
11.4.2	A Noncredible Exchange-Rate-Based Inflation-Stabilization Program	412
11.5	Balance-of-Payments Crises	413
11.6	Discussion and Extensions	418
11.7	Appendix: The Hamiltonian	420
11.8	Exercises	422
12	Financial Frictions and Aggregate Instability	425
12.1	Stock Collateral Constraints	426
12.1.1	The Steady-State Equilibrium	429
12.1.2	Frictionless Adjustment to Regular Shocks	431
12.1.3	Adjustment to Large Shocks: Fisherian Debt Deflations and Deleveraging	432
12.2	Stock Collateral Constraints and Self-Fulfilling Financial Crises	436
12.3	Flow Collateral Constraints	438
12.4	Flow Collateral Constraints and Self-Fulfilling Financial Crises	442
12.5	Debt Dynamics in a Stochastic Economy with a Flow Collateral Constraint	446
12.5.1	Calibration	447
12.5.2	Equilibrium Selection	448
12.5.3	Computation of Equilibrium	449
12.5.4	Equilibrium Debt Distributions	449
12.5.5	The Unconstrained Economy	450
12.6	Financial Amplification	453
12.7	Optimal Capital Control Policy	457
12.7.1	Overborrowing or Underborrowing? An Analytical Example	460
12.7.2	Implementation	461
12.8	Overborrowing and Underborrowing: A Quantitative Analysis	462
12.9	Is Optimal Capital Control Policy Macroprudential?	464
12.10	Optimal Consumption Taxes	468
12.11	Aggregate Versus Individual Collateral Constraints	470
12.12	Exercises	474
13	Sovereign Default	480
13.1	Empirical Regularities	481
13.1.1	Frequency and Length of Defaults	481

- 13.1.2 Haircuts 483
- 13.1.3 Debt and Default 484
- 13.1.4 Country Premia 485
- 13.1.5 Country Spreads and Default Probabilities: A Sample Mismatch Problem 485
- 13.1.6 Do Countries Default in Bad Times? 487
- 13.2 The Cost of Default: Empirical Evidence 490
 - 13.2.1 Exclusion from Financial Markets 490
 - 13.2.2 Output Losses 493
 - 13.2.3 International Trade Sanctions 496
- 13.3 Default Incentives with State-Contingent Contracts 499
 - 13.3.1 The Optimal Debt Contract with Commitment 500
 - 13.3.2 The Optimal Debt Contract without Commitment 501
 - 13.3.3 Direct Sanctions 502
 - 13.3.4 Reputation 506
- 13.4 Default Incentives with Non-State-Contingent Contracts 512
 - 13.4.1 The Eaton-Gersovitz Model 513
 - 13.4.2 The Default Set 514
 - 13.4.3 Default Risk and the Country Premium 517
- 13.5 Saving and the Breakdown of Reputational Lending 518
- 13.6 Quantitative Analysis of the Eaton-Gersovitz Model 520
 - 13.6.1 Serial Correlation of the Endowment Process 520
 - 13.6.2 Finite Exclusion Period 521
 - 13.6.3 Output Cost of Default 522
 - 13.6.4 The Model 523
 - 13.6.5 Calibration and Functional Forms 524
 - 13.6.6 Computation 526
 - 13.6.7 Quantitative Predictions of the Eaton-Gersovitz Model 527
 - 13.6.8 Dynamics Around a Typical Default Episode 530
 - 13.6.9 Goodness of Approximation of the Eaton-Gersovitz Model 531
 - 13.6.10 Alternative Output Cost Specification 533
 - 13.6.11 The Quantitative Importance of Output Costs of Default 534
 - 13.6.12 The Quantitative Irrelevance of Exclusion 536
 - 13.6.13 The Role of Discounting 538
 - 13.6.14 Changing the Volatility of the Endowment Process 538
 - 13.6.15 Time-Varying Volatility, Country Spreads, and Default 539
 - 13.6.16 Varying the Persistence of the Output Process 540
- 13.7 The Welfare Cost of Lack of Commitment 541

- 13.8 Decentralization of the Eaton-Gersovitz Model 543
 - 13.8.1 Households 544
 - 13.8.2 The Government 544
 - 13.8.3 Competitive Equilibrium 545
 - 13.8.4 Equilibrium under Optimal Capital Control Policy 546
 - 13.8.5 The Optimal-Policy Equilibrium as a Decentralization of the Eaton-Gersovitz Model 547
 - 13.8.6 Capital Control Dynamics 549
 - 13.8.7 Optimal Default Policy without Capital Controls 549
- 13.9 Risk-Averse Lenders 552
- 13.10 Long-Term Debt and Default 556
 - 13.10.1 A Random-Maturity Model 557
 - 13.10.2 A Perpetuity Model 559
 - 13.10.3 The Perpetuity Model as a Special Case of the Random-Maturity Model 561
 - 13.10.4 Endogenous Choice of Maturity 561
- 13.11 Debt Renegotiation 565
 - 13.11.1 The Eaton-Gersovitz Model with Debt Renegotiation 566
 - 13.11.2 Quantitative Predictions of the Debt-Renegotiation Model 568
- 13.12 Default and Monetary Policy 571
 - 13.12.1 The Twin Ds 571
 - 13.12.2 A Model of the Twin Ds 572
 - 13.12.3 Optimality of the Full-Employment Devaluation Policy 578
 - 13.12.4 Default Dynamics under Optimal Devaluation Policy and Currency Pegs 579
- 13.13 Appendix: Sovereign Default Dates, 1975–2014 582
- 13.14 Exercises 586

References 591

Index 601