

---

## Contents

---

<b>Introduction</b> . . . . .	xi
Monica BILLIO, Loriane PELIZZON and Roberto SAVONA	
<b>Part 1. Risk Connections and Systemic Risk Indicators</b> . . . . .	1
<b>Chapter 1. Systemic Risk via Dynamic Correlations</b> . . . . .	3
Petros DELLAPORTAS, Anastasios PLATANIOTIS and Michalis K. TITSIAS	
1.1. Introduction . . . . .	3
1.2. The problem . . . . .	4
1.3. Review . . . . .	6
1.3.1. Basic model . . . . .	6
1.3.2. CCC model . . . . .	6
1.3.3. Generalized CCC model . . . . .	7
1.3.4. Dynamic conditional correlation model . . . . .	8
1.3.5. Heavy-tailed models . . . . .	11
1.3.6. Additive factor models . . . . .	11
1.3.7. Wishart processes . . . . .	15
1.3.8. Generalized orthogonal models . . . . .	19
1.3.9. Cholesky stochastic volatility models . . . . .	22
1.4. The model of Dellaportas <i>et al.</i> . . . . .	23
1.5. Estimation with nested Laplace approximations . . . . .	25
1.5.1. Nested Laplace approximation . . . . .	27
1.5.2. Bayes factors . . . . .	29
1.5.3. Prediction . . . . .	30
1.6. Empirical studies . . . . .	30
1.6.1. Competing models . . . . .	30

1.6.2. Comparison against a proxy. . . . .	31
1.6.3. FTSE 100 data. . . . .	33
1.7. Conclusion . . . . .	37
1.8. Bibliography . . . . .	38
<b>Chapter 2. Systemic Risk and Financial Interconnectedness: Network Measures and the Impact of the Indirect Effect . . . . .</b>	<b>43</b>
Monica BILLIO, Michèle COSTOLA, Roberto PANZICA and Loriana PELIZZON	
2.1. Introduction. . . . .	43
2.2. Methodology . . . . .	45
2.2.1. Quantile-based loss measures: $\Delta\text{CoVaR}$ . . . . .	45
2.2.2. Network systemic risk measures . . . . .	47
2.3. The data . . . . .	56
2.4. Empirical analysis . . . . .	58
2.4.1. Quantile-based loss measures: $\Delta\text{CoVaR}$ . . . . .	59
2.4.2. Quantile-based network measures . . . . .	60
2.4.3. Rank correlation among $\Delta\text{CoVaR}$ and network measures . . . . .	67
2.4.4. Predictive power of the measures . . . . .	68
2.5. Conclusion . . . . .	69
2.6. Acknowledgments. . . . .	70
2.7. Bibliography . . . . .	71
<b>Chapter 3. Are Critical Slowing Down Indicators Useful to Detect Financial Crises? . . . . .</b>	<b>73</b>
Hayette GATFAOUI, Isabelle NAGOT and Philippe DE PERETTI	
3.1. Introduction. . . . .	73
3.2. Theory . . . . .	75
3.3. Data and empirical application . . . . .	77
3.3.1. Log-indices . . . . .	80
3.3.2. Cumulative returns . . . . .	84
3.4. Conclusion . . . . .	89
3.5. Bibliography . . . . .	92
<b>Chapter 4. Onset of Financial Instability Studied via Agent-based Models . . . . .</b>	<b>95</b>
Yi-Fang LIU, Jørgen VITTING-ANDERSEN and Philippe DE PERETTI	
4.1. Introduction. . . . .	95

---

4.2. Experimental approach . . . . .	97
4.2.1. Participants . . . . .	98
4.2.2. Lottery-choice experiment . . . . .	98
4.2.3. Trading in a financial market . . . . .	98
4.3. Simulation approach . . . . .	101
4.3.1. The \$-Game . . . . .	101
4.3.2. Technical analysis strategies . . . . .	101
4.3.3. Fundamental analysis strategies . . . . .	105
4.3.4. Market dynamics . . . . .	105
4.3.5. Decoupling and synchronization . . . . .	107
4.4. Experimental results. . . . .	110
4.4.1. Experimental design . . . . .	110
4.4.2. Financial market results . . . . .	113
4.5. Simulation results . . . . .	118
4.5.1. Macroscopic simulation analysis. . . . .	118
4.5.2. Microscopic simulation analysis . . . . .	120
4.6. Conclusion . . . . .	122
4.7. Acknowledgments. . . . .	123
4.8. Bibliography . . . . .	123
<b>Part 2. Early Warning System for Systemic Risk(s) . . . . .</b>	<b>127</b>
<b>Chapter 5. Score-driven Systemic Risk Signaling for European Sovereign Bond Yields and CDS Spreads . . . . .</b>	<b>129</b>
Rutger-Jan LANGE, André LUCAS and Arjen SIEGMANN	
5.1. Introduction. . . . .	129
5.2. Score-driven systemic risk models . . . . .	131
5.3. Data . . . . .	135
5.3.1. CDS . . . . .	135
5.3.2. Bonds . . . . .	136
5.4. Empirical results. . . . .	139
5.4.1. Systemic risk based on CDS versus bond spreads. . . . .	139
5.4.2. Joint default probability prior to 2008. . . . .	142
5.4.3. Conditional default probability . . . . .	142
5.4.4. Decomposition of risk . . . . .	143
5.4.5. Comparison with simple measures. . . . .	146
5.5. Conclusion . . . . .	148
5.6. Bibliography . . . . .	149

<b>Chapter 6. Model-based Business Cycle and Financial Cycle Decomposition for Europe and the United States . . . . .</b>	151
Siem Jan KOOPMAN, Rutger LIT and André LUCAS	
6.1. Introduction . . . . .	151
6.2. Data . . . . .	154
6.3. Multivariate unobserved components model . . . . .	155
6.3.1. Phase shifts . . . . .	157
6.3.2. Linear Gaussian state space model. . . . .	158
6.4. Results of empirical study . . . . .	160
6.5. Conclusion . . . . .	166
6.6. Bibliography . . . . .	167
<b>Chapter 7. Danger Zones for the Financial System . . . . .</b>	169
Paolo MANASSE, Roberto SAVONA and Marika VEZZOLI	
7.1. Introduction . . . . .	169
7.2. Risk stratification: from regression trees to ensemble learning . . . . .	171
7.2.1. Regression and classification trees. . . . .	171
7.2.2. Heatmaps. . . . .	173
7.2.3. Random forest. . . . .	174
7.2.4. A novel algorithm: CRAGGING. . . . .	175
7.3. Implementing an early warning system . . . . .	176
7.3.1. Sovereign systemic risk . . . . .	176
7.3.2. Banking risk . . . . .	179
7.3.3. Hedge fund risk . . . . .	185
7.4. Conclusion . . . . .	188
7.5. Bibliography . . . . .	188
<b>Chapter 8. Risk Monitoring Systems in Real-time Based on Dynamic Factor Models . . . . .</b>	191
Marcella LUCCHETTA	
8.1. Introduction . . . . .	191
8.2. Systemic risks: definitions and measurement . . . . .	196
8.3. The model. . . . .	197
8.3.1. Density forecasts and systemic risk measures . . . . .	198
8.4. Estimation and forecasting. . . . .	200
8.5. Identification and stress testing . . . . .	201
8.5.1. Theory-based identification . . . . .	201
8.5.2. Stress testing. . . . .	204

---

8.6. Implementation . . . . .	205
8.6.1. Estimation . . . . .	206
8.6.2. Forecasting . . . . .	207
8.6.3. Identification of structural shocks . . . . .	210
8.7. Conclusion . . . . .	213
8.8. Appendix A: tables and figures . . . . .	214
8.9. Appendix B: list of variables . . . . .	229
8.10. Bibliography . . . . .	231
<b>Part 3. Policy Implications . . . . .</b>	<b>237</b>
<b>Chapter 9. Policy Lessons from Systemic Risk Modeling and Measurement . . . . .</b>	<b>239</b>
Arjen SIEGMANN	
9.1. Introduction . . . . .	239
9.2. Prevention . . . . .	241
9.2.1. The accuracy of early-warning models for systemic risk . . . . .	241
9.2.2. Using market-implied volatility as a warning signal . . . . .	246
9.3. Mitigation . . . . .	251
9.3.1. Managing the financial cycle . . . . .	251
9.3.2. Identifying systemically important institutions . . . . .	255
9.4. Stabilization . . . . .	257
9.4.1. Stabilizing the sovereign bond market . . . . .	257
9.4.2. Acknowledging the complexity of the financial system . . . . .	259
9.4.3. The policy maker's loss function . . . . .	265
9.5. Conclusion . . . . .	266
9.6. Bibliography . . . . .	267
<b>List of Authors . . . . .</b>	<b>275</b>
<b>Index . . . . .</b>	<b>277</b>