

# Contents

<b>1</b>	<b>Introduction</b> .....	1
<b>2</b>	<b>Formation of IT Features Through Interaction with Institutional Systems: Empirical Evidence of Unique Epidemic Behavior</b> .....	3
2.1	Introduction .....	3
2.2	Features of IT with Respect to Institutions .....	6
2.2.1	Formation Process of Specific Features of Technology .....	6
2.2.2	Analysis of Epidemic Behavior .....	7
2.2.3	Features of IT .....	15
2.3	Implications .....	19
2.4	Conclusion .....	21
Appendix 1	Mathematical Development of Logistic Growth Function Within a Dynamic Carrying Capacity .....	22
Appendix 2	Data Construction and Sources .....	24
A.2.1	Refrigerators .....	24
A.2.2	Color TV Sets .....	25
A.2.3	Cellular Telephones .....	25
Appendix 3	Mathematical Development of SCE .....	25
References	.....	29
<b>3</b>	<b>Institutional Elasticity as a Significant Driver of IT Functionality Development</b> .....	31
3.1	Introduction .....	31
3.2	Identification of IT Features with Respect to Institutions .....	33
3.2.1	The Formation Process of Specific Features of Technology .....	33
3.2.2	Analysis of Epidemic Behavior .....	35
3.2.3	Features of IT .....	46
3.3	Implications .....	49
3.4	Conclusion .....	50
Appendix	Data Construction and Sources .....	52
Appendix 1	TFP and IT Intensity .....	52

Appendix 2	Epidemic Behavior .....	52
A.2.1	Refrigerators (1951–1999) .....	53
A.2.2	Fixed Telephones (1953–1999) .....	53
A.2.3	Japanese Word Processors (1982–1997) .....	54
A.2.4	Color TV Sets (1966–2000) .....	54
A.2.5	Personal Computers (1987–2000) .....	54
A.2.6	Cellular Telephones (1996–2001) .....	54
References	.....	55
<b>4</b>	<b>A Substitution Orbit Model of Competitive Innovations</b> .....	<b>57</b>
4.1	Introduction .....	57
4.2	Substitution Orbit of Competitive Innovations .....	59
4.2.1	Substitution Orbit: Japan’s Experiences .....	59
4.2.2	Comparative Assessment of Substitution Orbits .....	64
4.3	Lotka–Volterra Equations for Predator–Prey Systems .....	65
4.3.1	General Orbit Within Lotka–Volterra Equations .....	65
4.3.2	Factors Governing the Twisting of an Orbit .....	67
4.3.3	General Image of an Elliptical Orbit .....	72
4.4	Orbit for Substitution: Policy Option in a Complex Orbit .....	73
4.4.1	Maximum Diffusion Scale: $d$ .....	77
4.4.2	Carrying Capacity: $k_y$ .....	77
4.4.3	Interaction Coefficient: $\alpha_{yx}$ .....	78
4.5	Conclusion .....	78
References	.....	79
<b>5</b>	<b>Impacts of Functionality Development on Dynamism Between Learning and Diffusion of Technology</b> .....	<b>81</b>
5.1	Introduction .....	81
5.2	Dynamic Behavior of Learning Coefficient .....	83
5.3	Learning and Diffusion of Technology .....	88
5.3.1	Learning Coefficient Function Incorporating Functionality Decrease .....	89
5.3.2	Technology Diffusion Trajectory Reflecting Functionality Decrease Effects .....	92
5.3.3	Linking Learning and Diffusion of Technology .....	96
5.4	Institutional Dynamism Leading to a Dynamic Interaction Between Learning, Diffusion and Spillover of Technology .....	96
5.5	Conclusion .....	99
References	.....	102
<b>6</b>	<b>Diffusion, Substitution and Competition Dynamism Inside the ICT Market: A Case of Japan</b> .....	<b>103</b>
6.1	Introduction .....	104
6.2	Methodology .....	107
6.2.1	Model Synthesis .....	107
6.2.2	Data Construction .....	111

6.3	Diffusion and Substitution Process of ICT in Japan: Empirical Analysis with Diffusion and Substitution Models .....	111
6.3.1	Telephony Market in Japan .....	111
6.3.2	Mobile Telephony Market in Japan .....	115
6.3.3	Internet Access in Market Japan .....	122
6.4	Conclusion .....	128
6.4.1	General Summary .....	128
6.4.2	New Findings .....	129
6.4.3	Policy Implications .....	131
6.4.4	Future Works .....	132
	References .....	133
<b>7</b>	<b>The Co-Evolution Process of Technological Innovation: An Empirical Study of Mobile Phone Vendors and Telecommunication Service Operators in Japan .....</b>	<b>135</b>
7.1	Introduction .....	136
7.1.1	Background .....	136
7.1.2	Hypotheses .....	138
7.1.3	Existing Works .....	139
7.1.4	Prime Objectives of the Investigation .....	140
7.1.5	Structure of the Chapter .....	141
7.2	A Market Dominated by High-End Handsets Due to High Learning Effect .....	141
7.2.1	Methodology .....	141
7.2.2	Results and Discussion .....	143
7.3	A Market Dominated by Order-Made Models Due to Close Cooperation Between Vendors and Operators .....	147
7.3.1	Methodology .....	147
7.3.2	Results and Discussion .....	148
7.4	A Virtuous Cycle Between Demand and Supply Sides Driving Japan's Co-Evolutionary Mobile-Driven Innovations and Institutions .....	153
7.5	Conclusions .....	155
7.5.1	General Summary .....	155
7.5.2	New Findings .....	155
7.5.3	Policy Implications .....	156
7.5.4	Future Works .....	156
	References .....	157
<b>8</b>	<b>Technopreneurial Trajectory Leading to Bipolarization of Entrepreneurial Contour in Japan's Leading Firms .....</b>	<b>159</b>
8.1	Introduction .....	159
8.2	Co-Evolutionary Dynamism Between Mobile Phone Driven Innovation and Institutional Systems: <i>Cumulative Learning Leading to Creating New Functionality</i> .....	161

8.2.1	Dramatic Decline in Japan's Productivity in an Information Society in the 1990s .....	161
8.2.2	Mobile Phone Driven Innovation Emerged in the 2000s ...	161
8.2.3	Swell of Reactivation of the Co-Evolutionary Dynamism ..	166
8.2.4	Implications .....	169
8.3	Transformation in Entrepreneurial Contour in Leading Firms Facing the Transition to a Post Information Society: <i>Output-Oriented R&amp;D Based on External Acquisition</i> .....	170
8.3.1	Co-Evolution in High-Technology Firm Technopreneurial Structure .....	170
8.3.2	Bi-Polarization in Technopreneurial Situation .....	171
8.3.3	External Acquisition for OIR Substitution for R&D Intensity .....	173
8.3.4	Implications .....	175
8.4	Conclusion .....	176
	References .....	177
<b>9</b>	<b>Technological Diversification: Strategic Trajectory Leading to an Effective Utilization of Potential Resources in Innovation: A Case of Canon</b> .....	179
9.1	Introduction .....	179
9.2	R&D Diversification and Assimilation of Spillover Technology ...	181
9.2.1	Increasing Dependency on Spillover Technology .....	181
9.2.2	Technology Distance, Technological Proximity and Technological Position .....	181
9.2.3	R&D Diversification and Technological Distance .....	184
9.3	Measurement of Technological Diversification .....	185
9.3.1	Measurement of Canon's Technology Development Trajectory .....	185
9.3.2	Measurement of Technological Diversification .....	187
9.4	Contribution of Technological Diversification to High Income Structure .....	191
9.4.1	Contribution to Operating Income to Sales (OIS) .....	191
9.4.2	Technological Diversification and Marginal Productivity of Technology .....	195
9.4.3	Technological Diversification and Increase in Total Factor Productivity .....	201
9.4.4	Technological Diversification and Internal Rate of Return to R&D Investment .....	202
9.5	Factors Inducing a Virtuous Cycle Between R&D Investment and Technological Diversification .....	204
9.5.1	Inducing Factors of Technological Diversification .....	204
9.5.2	Factors Governing Internal Rate of Return to R&D Investment .....	206

9.5.3	Dynamism Leading to a Virtuous Cycle for Technological Diversification .....	206
9.6	Conclusion .....	207
	References .....	208
<b>10</b>	<b>Japan's Coevolutionary Dynamism Between Innovation and Institutional Systems: <i>Hybrid Management Fusing East and West</i></b> .....	<b>211</b>
10.1	Introduction .....	211
10.2	Japan's Indigenous Explicit Function .....	212
10.2.1	Japan's Development Trajectory: Historical Perspectives ...	212
10.2.2	Japan Indigenous Institutional Systems for Innovation .....	213
10.2.3	Inducement of Innovation: Overcoming the Growth Constraints .....	213
10.2.4	Technology Substitution for Constrained Production Factors .....	214
10.2.5	Conspicuous Energy Efficiency and World Top Level Manufacturing Technology .....	214
10.3	Lost Decade and Reactivation .....	216
10.3.1	Contrast Between Coevolution and Disengagement .....	216
10.3.2	Reactivation of Coevolutionary Dynamism .....	219
10.4	Hybrid Management: Fuses East and West .....	221
10.4.1	Japan's Indigenous Potential in Fusing: Learning and Assimilation .....	221
10.4.2	Swell of Japan's Institutional MOT Toward a Post-Information Society .....	223
10.5	Canon's Success in Hybrid Management .....	224
10.5.1	Canon's Conspicuous Performance .....	224
10.5.2	Functionality Development as a Source of High-Performance .....	225
10.5.3	Fusing Option .....	226
10.5.4	Global Co-evolution for Sustainable Development .....	228
10.6	Conclusion .....	228
	References .....	230
<b>11</b>	<b>Conclusion</b> .....	<b>233</b>
11.1	Formation of IT Features Through Interaction with Institutional Systems: <i>Empirical Evidence of Unique Epidemic Behavior</i> .....	233
11.2	Institutional Elasticity as a Significant Driver of IT Functionality Development .....	234
11.3	A Substitution Orbit Model of Competitive Innovations .....	235
11.4	Impacts of Functionality Development on Dynamism Between Learning and Diffusion of Technology .....	236

11.5	Diffusion, Substitution and Competition Dynamism Inside the ICT Market: <i>A Case of Japan</i> .....	238
11.6	The Co-evolution Process of Technological Innovation: <i>An Empirical Study of Mobile Phone Vendors and Telecommunication Service Operators in Japan</i> .....	242
11.7	Technopreneurial Trajectory Leading to Bipolarization of Entrepreneurial Contour in Japan's Leading Firms .....	244
11.8	Technological Diversification: Strategic Trajectory Leading to an Effective Utilization of Potential Resources in Innovation: <i>A Case of Canon</i> .....	245
11.9	Japan's Co-evolutionary Dynamism Between Innovation and Institutional Systems: <i>Hybrid Management Fusing East and West</i> .....	246