

Author index

- Abernathy, W. J., 10
 Anderson, P., 62–66
- Bottazzi, G., 7–9
 Brenner, T., 36–37
 Breschi, S., 6
 Bresnahan, T. F., 10, 43
- Capone, G., 233–235
 Christensen, C. M., 62–66
 Clark, K. B., 10, 62–66
 Cohen, W. M., 5
 Cournot, A. A., 26–27
 Cyert, R. M., 29–32
- Darwin, C., 28–29
 Dorfman, N., 10
 Dosi, G., 10, 33–36, 51–56
- Flamm, K., 10, 43
 Fontana, R., 36–37
 Friedman, M., 23–24, 31–32
- Gambardella, A., 10
 Garavaglia, C., 231–235,
 Gould, S.J., 28–29
 Greenstein, S., 10, 43
 Guerzoni, M., 36–37
- Henderson, R., 62–66
- Kim, C. W., 36–37
 Kitcher, P., 24–25
 Klein, B., 10
 Klepper, S., 12–13, 17–18, 33–36,
 197–203
- Lancaster, K. J., 47–51
 Langlois, R. N., 43
 Lee, K., 36–37
 Levin, R. C., 5
- Malerba, F., 6, 10, 36–37, 43, 231–233, 235–237
 March, J. G., 29–32
 Marengo, L., 51–56
 Marshall, A., 1–4, 26–27, 217–221
 Mowery, D., 10
 Murmann, P., 18–19, 36–37
- Nelson, R., 6, 26–27, 31–32, 33–36, 40–41,
 51–56, 96–101, 226–227
 Nuovolari, A., 36–37
- Oltra, V., 36–37
 Orsenigo, L., 6, 10
- Pavitt, K., 5
 Phillips, A., 10
 Pisano, G., 51–56
- Rosenberg, N., 10
 Rosenbloom, R., 62–66
- Saint Jean, M., 36–37
 Schuette, H., 33–36
 Schumpeter, J., 1–4, 26–27
 Shuen, A., 51–56
 Silverberg, G., 33–36
 Simon, H., 29–32
 Simons, K., 10
 Smith, A., 26–27
 Sutton, J., 5
- Teece, D., 51–56
 Thompson, P., 197–203
 Tushman, M. L., 62–66
- Williamson, O., 97n.4
 Wilson, E.O., 28–29
 Winter, S., 6, 26–27, 31–32, 33–36, 40–41,
 51–56, 96–101, 226–227
- Yoon, M., 36–37

Subject index

- adaptability, industrial innovation and, 16–17
- advertising
 - innovation dynamics and, 51–56
 - market dynamics in computer industry and, 56–61
- agent-based modeling, 38–42
- agent behavior, evolutionary economics and, 29–32
- aggregation
 - drug market fragmentation and, 197–203, 205–208
 - imitation and patent protection in pharmaceutical firms and, 188–193
 - industry life cycle and, 13–14
 - opportunities for drug innovation and, 194–196
 - pharmaceutical history-friendly simulation runs, 180–183
 - in pharmaceutical industry, 164–167
- Amgen, 157–158
- Anatomical Therapeutic Chemical (ATC) Classification System, 151n.1
- ANOVA test, robustness analysis, pharmaceutical industry modeling, 212–213
- antitrust actions, interdependent market dynamics and, 235–237
- Apple Computer, 96
- appreciative theory, 41–42
 - evolutionary modeling and, 32–36
 - history-friendly modeling (HFM), 22–29
 - market dynamics in computer industry and, 56–61
 - modeling methodology and, 217–221
- appropriability of innovation
 - drug imitation and, 160–162
 - patent protection for drug innovation and, 164–167
 - pharmaceutical simulations and, 188–208
 - technology development and, 4–6, 226–227
- arbitrage principle, drug market fragmentation and, 197–203
- bandwagon effects
 - history-divergent simulation, 74–78
 - history-friendly modeling of vertical integration, 122–127
 - mainframe demand and absence of, 130–132
 - market dynamics in computer industry and, 56–61
 - semiconductor demand and absence of, 132–134
 - vertical integration and, 134–137
- Bayer company, 151–152
- behavior
 - evolutionary economics and, 29–32
 - in history-based modeling, 38–42
 - modeling methodology and, 217–221
- biology, formal modeling based on, 28–29
- biotechnology revolution
 - pharmaceutical history-friendly simulation runs and, 180–183
 - pharmaceutical industry and, 157–158
- bounded rationality
 - evolutionary economics and, 29–32
 - NK modeling approach, 243–245
 - vertical integration/dis-integration theory and, 96–101
- brand loyalty effects
 - market dynamics in computer industry and, 56–61
 - pharmaceutical pricing and marketing and, 173–174
 - in vertical integration model, 101–104
- Burroughs, 43–48, 94–96
- buyers. *See* customer preferences

- capability-based firm perspective, vertical integration and, 96–101, 134–137
- Capitalism, Socialism and Democracy* (Schumpeter), 6
- catching up dynamics, industrial evolution and, 239–240
- causation, vertical integration and, 99n.5
- CES function, vertical integration/dis-integration and, 104–106
- cheapness
 - firm research and development behavior and, 110–116
 - history-friendly model of computers and, 47–51
 - innovation dynamics and, 51–56
 - market dynamics in computer industry and, 58–59
 - in vertical integration model, 101–104
- chemical industry, origins of pharmaceutical industry and, 151–152
- “chemically- and bio-equivalent” drug brands, innovation and imitation and, 160–162
- Ciba, 151–152
- clean technology, evolution of, 36–37
- Cobb-Douglas function, market dynamics in computer industry and, 58–59
- Commodore, 96
- compatibility issues, demand for computers and, 106–108
- competence destruction, vertical integration and, 99–100
- competence development
 - cumulative competencies and transition dynamics, 62–66
 - diversification strategies, 77n.20
 - innovation dynamics and, 51–56
 - in pharmaceutical industry, 151–152
 - vertical integration/dis-integration and, 93, 96–101
- competition
 - competing technologies in computer industry and, 61–62
 - demand regimes, 227
 - market demand for components and, 108–110
 - in pharmaceuticals industry, 158–164
 - pharmaceuticals industry modeling and, 150–151
 - in vertical integration model, 101–104
- component technology
 - absence of external market for, vertical integration and, 128–130
 - exit rule for producers of, 121–122
 - firm research and development behavior and, 110–116
 - history-friendly modeling of vertical integration, 122–127
 - market for components and, 108–110
 - specialization vs. vertical integration in, 119–121
 - technical progress in, 116–119
 - vertical integration/dis-integration and, 104–106
- computer technology/computer industry
 - competing technologies, 61–62
 - demand for computers and, 106–108
 - evolution of, 43–48
 - exit rules for, 121–122
 - exogenous change in, 228–229
 - history-friendly modeling of, 47–51, 122–127
 - history-replicating simulations, 66–68
 - international comparisons in, 238–239
 - market dynamics in, 56–61
 - model of vertical integration in, 101–104
 - semiconductor industry and, 94–96
 - transition dynamics in, 62–66
 - vertical integration/dis-integration in, 93, 100–101
- concentration. *See also* Herfindahl index of concentration
 - drug market fragmentation and, 197–203
 - imitation and patent protection in pharmaceutical firms and, 188–193
 - in mainframe industry, absence of bandwagon effects and, 130–132
 - opportunities for innovation and, 194–196
 - pharmaceutical history-friendly simulation runs, 180–183
 - in pharmaceutical industry, 158–164
- consumer preferences
 - demand for computers and, 106–108
 - drug demand and sales and, 175–177
 - market dynamics in computer industry and, 58–59
 - pharmaceutical pricing and marketing and, 173–174
 - in vertical integration model, 101–104

266 SUBJECT INDEX

- continuous technological improvement
 - computer industry history and, 43–48
 - vertical integration/dis-integration and, 104–106
- contract theory, vertical integration/dis-integration and, 96–101, 134–137
- Control Data, 43–48, 94–96
- counterfactual simulations
 - computer industry modeling, 47–51, 66–68, 122–127
 - pharmaceutical industry modeling, 188–205
 - vertical integration modeling, 127–128
- cumulativeness
 - drug innovation and, 196–197, 205–208
 - innovation and, 4–6
 - NK modeling approach and, 243–245
 - technical progress and, 116–119
 - in technological regimes, 225–226
- “Darwin’s Achievement” (Kitcher), 24–25
- DEC, 43–48
- demand behavior
 - absence of bandwagon effects and, 130–132
 - competition and, 227
 - computer industry and, 56–61
 - demand and technology regimes and, 231–233
 - history-friendly modeling of computer industry and, 126–127
 - history-replicating simulations, 68–74
 - industrial dynamics and, 231–233
 - merchant-specialized producers and, 95n.3
 - in pharmaceutical industry, 153–154, 175–177, 205–208
 - semiconductor demand, absence of bandwagon effects, 132–134
 - vertical integration model and, 106–108
- design attributes
 - trajectories in, 15–16
 - in vertical integration model, 101–104
- design innovation, integrated circuits
 - technology and, 95n.3
- development activities
 - cumulativeness in, 196–197
 - drug innovation and imitation and, 170–171
- Diamond v. Chakrabarty*, 153–154
- “A Diffusion Model of International Productivity Differences in Manufacturing Industry,” 33–36
- diffusion curves, evolutionary economics and, 33–36
- diversification
 - pharmaceutical history-friendly simulation runs and, 183–186
 - strategies for, 77n.21
 - transition dynamics and, 62–66
- DNA technology, pharmaceutical industry and, 156–157
- “dominant design” of products
 - emergence of, 9–15
 - semiconductor industry example, 13–14
- draws, cost of
 - cumulativeness in drug development and, 196–197
 - drug diversification, innovation and imitation and, 185n.18
 - technical progress and, 116–119
- drug discovery process, 156–157, 162–164
 - cumulativeness in, 196–197
 - innovation vs. imitation, 160–162, 169–170
 - market fragmentation and, 197–203
 - opportunities for innovation and, 194–196
 - parallel projects and project selection, 171–173
 - pharmaceuticals industry modeling and, 150–151
 - therapeutic classes and, 164–167
- economic theory
 - behavioral assumptions, evolutionary economics and, 29–32
 - concentration and innovation performance, 158–164
 - first-mover advantages in pharmaceuticals industry, 203–205
 - historical evaluation of, 22–29
 - history-replication simulations and, 66–68
- elasticity of substitution, vertical integration/dis-integration and, 104–106
- electronics industry, history-friendly modeling of, 36–37
- entry conditions
 - competing technologies and, 61–62
 - computer industry, 43–48
 - evolutionary economics and, 33–36

- history-friendly modeling (HFM), 78–80
- industrial evolution and, 233–235
- industry life cycle model, 9–15
- innovation and, 7–9
- pharmaceutical history-friendly simulation runs, 180–183
- in pharmaceutical industry, 157–158
- pharmaceuticals industry, overview, 150–151
- public knowledge variable and, 116–119
- escalation parameter, drug market fragmentation and, 197–203
- Europe
 - computer industry history in, 43–48
 - pharmaceutical industry in, 151–158
- evolutionary modeling
 - behavioral assumptions in evolutionary economics, 29–32
 - computer technology and industry, 43–48
 - history of, 32–36
 - history-replicating simulations, 66–68
 - industrial innovation and, 1–4, 233–235
 - life cycle of industries and, 9–15
 - patterns in, 15–19
 - pharmaceuticals industry, overview, 150–151
 - research methodology and, 19–20
 - theory evaluation and, 22–29
- exit rates for new firms
 - absence of external markets and, 128–130
 - evolutionary economics and, 33–36
 - industry life cycle model, 9–15
 - pharmaceutical history-friendly simulation runs, 180–183
 - pharmaceutical industry and, 178
 - profits and returns and, 51–56
 - vertical integration and, 121–122
- exogenous change, in computer industry, 228–229
- external markets
 - absence of, for components, vertical integration and, 128–130
 - for components, 108–110
 - history-friendly modeling of vertical integration, 122–127
 - vertical integration and, 134–137
- financial resources and policies
 - budget and accounting in drug industry and, 177–178
- firm research and development behavior and, 110–116
- industry dynamics and, 51–56
- innovation dynamics and, 51–56
- pharmaceutical firms, 168–169
- transition dynamics and, 62–66
- firm size
 - history-replicating simulations, 66–68
 - imitation and patent protection in pharmaceutical firms and, 188–193
 - industrial innovation and, 4–6, 12
 - industry structure and, 221–222
 - in pharmaceutical industry, 158–164
 - vertical integration and, 99–100
 - vertical integration model and, 101–104
- first-generation mainframe firms
 - competing technologies in computer industry and, 61–62
 - history-divergent simulation, 74–78
 - history-replicating simulations, 66–74,
 - transition dynamics and, 62–66
- first-mover advantages
 - industrial evolution and, 233–235
 - in pharmaceuticals industry, 203–205
- Food and Drug Administration, 156–157
- formal modeling
 - assessment of, 217–221
 - history-friendly modeling and, 22–29
 - market dynamics in computer industry and, 59–61
 - pharmaceutical industry model, 167–178
- fragmentation of markets
 - counterfactual pharmaceutical simulation and, 197–203
 - demand and technology regimes and, 231–233
 - increasing returns on innovation and, 222–224
 - in pharmaceutical industry, 150–151, 164, 205–208, 229–230
- game theory, drug market fragmentation and, 197–203
- Genentech, 157–158
- General Electric (GE), 43–48, 94–96
- generic drugs
 - innovation and imitation and, 160–162
 - patent law and, 153–154
- Gibrat law, 66–68, 186n.20

268 SUBJECT INDEX

- government technology investment
 - computer industry history and, 43–48
 - industrial innovation and, 18–19
 - pharmaceutical drug development and, 152–153
- guided search techniques, 156–157
- Hatch-Waxman Act, 153–154
- health insurance, pharmaceutical industry and spread of, 153–154
- Herfindahl index of concentration
 - absence of bandwagon effects and, 130–132
 - absence of external markets simulation, 128–130
 - cumulativeness in drug development and, 196–197
 - drug market fragmentation and, 197–203
 - history-divergent simulation, 74–78
 - history-replicating simulation, 68–74
 - imitation and patent protection in pharmaceutical firms and, 188–193
 - minor technological discontinuities and, 134
 - opportunities for drug innovation and, 194–196
 - pharmaceutical history-friendly simulation runs, 180–183
 - semiconductor demand, absence of bandwagon effects, 132–134
 - sensitivity analysis, history-friendly modeling, 85–92
 - sensitivity analysis, vertical integration, 143–149
 - submarket values, pharmaceutical industry, 201–203
 - vertical integration modeling, 122–127
- heterogeneity across firms
 - drug demand and sales and, 175–177
 - evolutionary economics and, 29–32
 - innovation and persistence of, 7–9
 - in pharmaceutical industry, 164–167
 - vertical integration/dis-integration and, 96–101
- heuristics, in design trajectories, 15–16
- history-divergent modeling, 68, 74–78
- history-friendly modeling (HFM)
 - absence of bandwagon effects and, 130–132
 - assessment of, 217–221
 - competition in pharmaceuticals industry and, 158–164
 - computer technology/computer industry, 43–48
 - creation and evaluation of, 38–42
 - dynamic environments and firm strategies and, 242–243
 - early work on, 36–37
 - element of firm dynamics, 51–56
 - evolutionary economics and, 33–36
 - evolution of computer industry and, 47–51
 - formal vs. appreciative theory, 22–29
 - future challenges in, 237–245
 - history-divergent simulation vs., 68
 - history-replicating simulation, 66–74,
 - horizontal scope in, 238
 - increasing returns on innovation and, 222–224
 - industrial evolution research, 1–4
 - overview, 22
 - pharmaceuticals industry, overview, 150–151
 - results and analyses, 78–80
 - sensitivity analysis, 85–92
 - simulation in pharmaceuticals industry and, 178–188
 - variables and parameters used in, 85
 - vertical integration, 122–127
- history-replicating simulations, 66–68
 - sensitivity analysis, 85–92
- Hoechst, 151–152
- Honeywell, 43–48, 94–96
- IBM, 94–96
 - computer industry history and role of, 43–48
 - history-replication simulation of, 66–68
 - mainframe dominance of, 74
 - personal computer market and, 96
 - vertical integration in, 94–96
- “IBM-compatible” standard, evolution of computer industry and, 46–47
- imitation
 - drug development activity and, 170–171, 205–208
 - drug patent protection and, 188–193
 - parallel projects and project selection in drug development and, 171–173
 - by pharmaceutical firms, 160–162, 169–170, 205–208
 - pharmaceutical history-friendly simulation runs and, 183–186

- increasing returns, innovation patterns and, 17–18, 222–224
- incumbent firms
 - innovation and, 7–9
 - pharmaceutical industry and, 157–158
 - transition dynamics and, 62–66
- “indifference curves,” history-friendly model of computers and, 47–51
- industrial evolution
 - catching up dynamics in, 239–240
 - contrasting opportunities in, 243–245
 - demand and technological regimes and, 231–233
 - emerging paradigms in, 240–242
 - entry conditions and, 233–235
 - firm growth and, 221–222
 - research methodology, 1–4
- industry life cycle (ILC) model
 - diffusion of innovation and, 33–36
 - early entrants as market leaders in, 17–18
 - innovation and, 9–15
 - policy interventions and, 235–237
- innovation, industrial
 - bounded rationality and, 29–32
 - computer industry dynamics in, 51–56
 - cumulativeness in drug industry and, 196–197
 - drug development activity and, 170–171
 - firm vulnerability and, 16–17
 - fragmentation of drug market and, 197–203
 - imitation and, 160–162, 169–170, 205–208
 - increasing returns and, 17–18, 222–224
 - industry life cycle (ILC) model of, 9–15
 - life cycle of industry and, 9–15
 - market structure and, 4–6
 - opportunities in drug discovery for, 194–196
 - parallel projects and project selection in drug development and, 171–173
 - pharmaceutical history-friendly simulation runs and, 183–186
 - in pharmaceutical industry, 154–156
 - pharmaceuticals industry modeling and, 150–151, 158–164
 - process in drug industry of, 162–164, 194–197
 - Schumpeter’s theories on, 6
 - “stylized facts” concerning, 7–9
 - technological regimes, opportunity in, 224–225
 - trajectories in, 15–16
 - transition dynamics in computer technology and, 62–66
- institutional structure, industry innovation and, 18–19
- integrated circuits
 - absence of external markets simulation for, 128–130
 - computer evolution and development of, 43–48
 - history-friendly modeling of vertical integration in, 122–127
 - market for, 108–110
 - semiconductors and, 101–104
 - vertical integration/dis-integration and, 100–101
 - vertical integration/dis-integration and introduction of, 94–96
- integration ratio
 - absence of bandwagon effects and, 130–132
 - absence of external markets simulation, 128–130
 - minor technological discontinuities and, 134
 - semiconductor demand, absence of bandwagon effects, 132–134
 - sensitivity analysis, vertical integration, 143–149
 - vertical integration modeling, 122–127
- Intel, 94–96
- intellectual property law
 - appropriability of innovation and, 226–227
 - innovation and, 18–19
- international comparisons, industrial innovation and evolution and, 238–239
- “invent around” strategies, drug innovation and, 160–162
- Japan, computer industry history in, 43–48
- Kefauver Committee, 156–157
- Kefauver-Harris Amendments, 156–157
- lock-in mechanism
 - market dynamics in computer industry and, 60n.11
 - reputational and compatibility issues and, 106–108

270 SUBJECT INDEX

- mainframe computers
 - absence of bandwagon effects, 130–132
 - absence of external markets and, 128–130
 - competing technologies and, 61–62
 - evolution of computer industry and, 43–48, 94–96
 - history-divergent simulation, 74–78
 - history-friendly modeling of, 47–51
 - history-replicating simulations, 66–74, semiconductors and, 101–104
 - transition dynamics and, 62–66
 - vertical integration/dis-integration and, 100–101
- market competencies. *See also* fragmentation of markets
 - components market, 108–110
 - computer industry dynamics and, 56–61
 - drug demand and sales and, 175–177
 - exit rules for computer firms and, 121–122
 - first-mover advantages in pharmaceuticals industry, 203–205
 - fragmentation in pharmaceuticals industry, 150–151
 - Herfindahl index time path, history-replicating simulations, 68–74
 - history-divergent simulation, 74–78
 - history-replicating simulations, 66–68
 - increasing returns and, 17–18
 - industrial innovation and, 4–6, 12
 - innovation dynamics and, 51–56
 - pharmaceutical pricing and, 173–174
 - pharmaceutical sales and marketing strategies, 167–168
 - pharmaceuticals industry, overview, 150–151
 - in pharmaceuticals industry, 158–164
 - public policy and, 235–237
 - transition dynamics and, 62–66
 - vertical integration and, 99–100
 - vertical integration/dis-integration theory and, 96–101
- markup, firm research and development behavior and, 110–116
- mathematical analysis
 - formal modeling and, 26–27, 217–221
 - innovation dynamics and, 51–56
 - “merit of design”
 - firm research and development behavior and, 110–116
 - technical progress and, 116–119
 - vertical integration/dis-integration and, 104–106
- merit thresholds, market dynamics in computer industry and, 59–61
- microprocessors
 - competing technologies and, 61–62
 - evolution of computer industry and, 46–47
- Herfindahl index time path in market for, 68–74
- history-friendly modeling of computer industry and, 47–51, 126–127
- market for, 108–110
- minor technological discontinuities and vertical integration increase for, 134
- semiconductor components and, 94–96
- semiconductor demand, absence of bandwagon effects, 132–134
- semiconductors and, 101–104
- transition dynamics and, 62–66
- vertical integration/dis-integration and, 100–101
- Microsoft, IBM alliance with, 46–47, 95
- miniaturization trajectories, 15–16
- minicomputer market
 - evolution of computer industry and, 43–48
 - integrated circuit technology and, 94–96
- molecular genetics
 - drug innovation and, 169–170
 - imitative pharmaceutical firms and, 169–170
 - pharmaceutical industry and, 156–157, 164–167
 - therapeutic classes and, 167–168
- Moore’s law, 15–16
- Myriad Genetics* case, 154n.3
- National Institutes of Health, 152–153
- natural selection, Friedman’s neoclassical behavioral assumptions and, 31–32
- NCR, 43–48, 94–96
- neoclassical behavioral theory, 31–32
- network externalities
 - demand for computers and, 106–108
 - dominant product design and, 9–15
- NK modeling approach, 243–245

- oligopoly, in pharmaceutical industry, 158–164
- opportunity
 - contrasting opportunities in industrial evolution, 243–245
 - drug innovation and, 194–196
 - increasing returns on innovation and, 222–224
 - in technological regimes, 224–225
- organizational structure
 - firm growth and, 221–222
 - firm research and development behavior and, 110–116
 - vertical integration and, 99–100
 - vertical integration/dis-integration and, 96–101
- outcome distribution, technical progress and, 116–119
- outsourcing
 - firm research and development behavior and, 110–116
 - market demand for components and, 108–110
- patent law
 - drug dominance and, 158–164
 - fragmentation of drug market and, 197–203, 229–230
 - imitation in pharmaceuticals and, 188–193
 - innovation and, 18–19
 - pharmaceutical industry and, 150–151, 153–154
 - prevention of drug imitation and, 160–162
- path-dependent strategies, firm rigidity and, 16–17
- PDP8 minicomputer, 45–46
- penicillin, development of, 152–153
- perception of innovation, transition dynamics and, 62–66
- performance
 - history-friendly model of computers and, 47–51
 - innovation dynamics and, 51–56
 - market dynamics in computer industry and, 58–59
 - in vertical integration model, 101–104
- personal computers
 - evolution of computer industry and role of, 46–47
- Herfindahl index time path in market for, 68–74
- history-divergent simulation, 74–78
- history-friendly modeling of vertical integration, 126–127
- history-replication simulation and, 66–68
- semiconductor components and, 94–96, 101–104
- transition dynamics and investment in, 62–66
- pharmaceuticals industry
 - budget and accounting issues in, 177–178
 - competition and market evolution in, 158–164
 - counterfactuals in simulations of, 188–205
 - cumulativeness in, 196–197
 - development activities in, 170–171
 - firm characteristics and, 168–169
 - firm diversification, innovation and imitation, 183–186
 - first-mover advantages in, 203–205
 - “golden age” in, 152–153
 - history-friendly simulation runs, 178–188
 - imitation and patent protection in, 188–193
 - innovation process in, 12–13, 194–197
 - market fragmentation in, 164, 197–203, 229–230
 - model overview, 150–151, 164–167
 - opportunities for innovation in, 194–196
 - parallel projects and project selection, 171–173
 - patent protection in, 150–151, 153–154, 229–230
 - pricing and marketing activity, 173–174
 - productivity decline in, 162–164
 - research methodology concerning, 19–20
 - sales and marketing strategies in, 167–168
 - sensitivity and robustness analysis of models of, 212–213
 - stylized history of, 151–158
 - summary of model results, 205–208
 - technological and market environment, 167–168
- politics, pharmaceutical industry and role of, 156–157
- prediction, history-friendly modeling (HFM) and, 22–29
- pricing decisions
 - history-friendly pharmaceutical model, 186–188

272 SUBJECT INDEX

- pricing decisions (cont.)
 - imitation and patent protection in
 - pharmaceutical firms and, 188–193
 - innovation dynamics and, 51–56
 - pharmaceutical marketing and,
 - 173–174
- Probit modeling, first-mover advantages in
 - pharmaceuticals industry, 203–205
- profits
 - drug industry budget and accounting and,
 - 177–178
 - drug industry diversification, innovation
 - and imitation and, 183–186
 - firm research and development behavior
 - and, 110–116
 - innovation dynamics and, 51–56
 - in pharmaceutical industry, 156–157
- proof of efficacy requirements, establishment
 - of, 156–157
- propensity for computer sales, performance
 - and cheapness and, 106–108
- proportionality factor
 - firm research and development behavior
 - and, 110–116
 - technical progress and, 116–119
- public knowledge variable, technical progress
 - and, 116–119
- public policy, interdependent market
 - dynamics and, 235–237
- quality threshold, drug demand and sales and,
 - 175–177
- “quasi-random” search procedures,
 - pharmaceuticals industry modeling
 - and, 150–151
- Radio Shack, 96
- random screening, pharmaceutical
 - innovation and, 150–151, 160–162
- rational choice, evolutionary economics and,
 - 29–32
- rational drug design, 156–157
- RCA, 43–48, 94–96
- reputational effects
 - demand for computers and, 106–108
 - transition dynamics and, 62–66
- research and development
 - drug innovation process and, 162–164
 - expansion in pharmaceutical industry of,
 - 154–156
 - firm behavior concerning, 12, 110–116,
 - 168–169
 - increasing returns on innovation and,
 - 222–224
 - innovation dynamics and, 51–56
 - in pharmaceutical industry, 151–158
 - pharmaceuticals industry, overview,
 - 150–151, 164–167
 - technical progress and, 116–119
 - vertical integration and, 134–137
 - in vertical integration model, 101–104
- robustness analysis, pharmaceutical industry
 - modeling, 212–213
- Sandoz, 151–152
- Schumpeter, Joseph
 - theories of innovation, 6, 33–36, 227
- Schumpeterian hypotheses, industrial
 - structure and innovation and, 4–6
- Schumpeter Mark I and Mark II, 6
- science-based industrial structure
 - innovation and, 4–6
 - technical progress and, 116–119
- screening programs, drug development and,
 - 160–162
- search process
 - cumulativeness in, 196–197
 - drug innovation and, 169–170
 - opportunities for innovation in, 194–196
- second-generation mainframe firms
 - competing technologies in computer
 - industry and, 61–62
 - history-divergent simulation, 74–78
 - history-replicating simulations, 68–74
- sector-specific mechanisms
 - drug innovation and, 168–169
 - industrial innovation and, 12
- semiconductor industry
 - absence of bandwagon effects and
 - specialization in, 130–132
 - absence of external markets simulation
 - for, 128–130
 - bandwagon effects in, 122–127
 - dominant design emergence in, 13–14
 - evolution of, 240–242
 - exogenous change in, 228–229
 - historical evolution of, 94–96
 - history-friendly modeling in, 36–37,
 - 122–127
 - international comparisons in, 238–239

- miniaturization trajectory in, 15–16
- research methodology concerning, 19–20
- specialization vs. vertical integration in, 119–121
- vertical integration/dis-integration in, 93
- in vertical integration model, 101–104
- sensitivity analysis
 - history-friendly modeling, 85–92
 - pharmaceutical industry simulation, 212–213
 - vertical integration/dis-integration modeling, 143–149
- “shakeout” phenomenon
 - industry life cycle and, 33–36
 - pharmaceutical history-friendly simulation runs and, 180–183
- simulation
 - history-divergent simulation, 68, 74–78
 - in history-friendly modeling, 38–42
 - history-replicating simulations, 66–74, methodological assessment, 217–221
 - pharmaceutical industry counterfactuals in, 188–205
 - vertical integration models, 122–134
- specialized computer firms
 - absence of bandwagon effects and increase in, 130–132
 - analysis of model results, 134–137
 - research and development behavior in, 110–116
 - vertical integration model and, 101–104, 119–121
- spillover effect, firm research and development behavior and, 114–116
- “spinoff” phenomenon, industry life cycle and, 33–36
- standard parameter values
 - drug market fragmentation and, 197–203
 - history-replicating simulations, 66–68, 85
 - imitation and patent protection in pharmaceutical firms and, 188–193
 - pharmaceutical history-friendly simulation runs, 178–188, 209–212
 - sensitivity analysis, 85–92
 - vertical integration models, 137–143
- statistical testing, history-friendly modeling (HFM), 22–29
- strategic interactions, vertical integration/dis-integration and, 96–101
- streptomycin, patentability of, 153–154
- “stylized facts”
 - evolution of industries, 15–19
 - industrial innovation and, 7–9
- submarket creation, drug market fragmentation and, 197–203, 205–208
- success-breeds-success processes
 - drug innovation and, 162–164
 - drug market fragmentation and, 197–203
- sulfa drugs, development of, 152–153
- synthetic dye industry, history-friendly modeling in, 36–37
- System 360 (IBM), 45
- system development
 - component technology and, 104–106
 - firm research and development behavior and, 110–116
 - integrated circuit technology and, 94–96
 - technical progress in, 116–119
 - vertical integration and, 96–104,
- technological discontinuities
 - absence of bandwagon effects and, 130–132
 - computers and semiconductors, 228–229
 - history-friendly model of, 122–127
 - industrial evolution and, 233–235
 - in microprocessors, vertical integration increase and, 134
 - vertical integration and, 99–100, 134–137
- technological paradigms
 - in design trajectories, 15–16
 - firm heterogeneity and, 16–17
- technology development
 - appropriability and, 226–227
 - cumulativeness and, 225–226
 - industrial dynamics and, 231–233
 - internal logic of, 4–6
 - opportunity and, 224–225
 - pharmaceuticals industry, 167–168
 - vertical integration and, 116–119
- thalidomide scandal, 156–157
- theory evaluation, formal vs. appreciative theory methodology, 22–29
- The Theory of Economic Development* (Schumpeter), 6

274 SUBJECT INDEX

- therapeutic classes
 - diversification, innovation and imitation and, 183–186
 - drug demand and sales and, 175–177
 - market dominance in pharmaceuticals and, 158–164
 - market fragmentation and, 197–203, 229–230
 - opportunities for drug innovation and, 194–196
 - pharmaceutical history-friendly simulation runs, 180–183
 - in pharmaceuticals industry, 151n.1, 164–167
 - technological and market environment in pharmaceuticals and, 167–168
- threshold requirements
 - drug development and, 175–177
 - market dynamics in computer industry and, 56–61
- trajectories, in innovation, 15–16
- transaction-cost approach, vertical integration/dis-integration, 96–101, 134–137
- transistor technology
 - absence of external markets simulation for, 128–130
 - competing technologies in computer industry and, 61–62
 - evolution of computer industry and, 43–48, 94–96
 - history-friendly model of, 47–51, 122–127
 - history-replicating simulations, 68–74
 - market for, 108–110
 - semiconductors and, 101–104
 - vertical integration/dis-integration and, 100–101
- transition dynamics
 - in computer industry, 62–66
 - public policy and, 235–237
- United States, computer industry dominance of, 43–48, 78–80
- unit production costs
 - firm research and development behavior and, 110–116
 - pharmaceutical pricing and marketing, 173–174
- Univac Rand, 43–48, 94–96
- user demands
 - history-friendly model of computers and, 47–51
 - market dynamics in computer industry and, 56–61
- US Patent Office, pharmaceutical patents and, 153–154
- variables lists
 - history-replicating simulations, 66–68, 85
 - vertical integration modeling, 137–143
- venture capital, innovation dynamics and, 51–56, 78–80
- vertical integration/dis-integration
 - absence of bandwagon effects and, 130–132
 - absence of external market for components and, 128–130
 - analysis of model results, 134–137
 - component technology and, 104–106
 - computer industry and, 93
 - counterfactual simulations, 127–128
 - evolution of computer industry and, 46–47
 - exit from market and, 121–122
 - firm research and development behavior and, 110–116
 - history-friendly modeling, 36–37, 122–127
 - industrial innovation, 13
 - in mainframe technology, 94–96
 - market demand for components and, 108–110
 - minor technological discontinuity in microprocessors and increase in, 134
 - model overview, 101–104
 - semiconductor demand, absence of bandwagon effects in, 132–134
 - sensitivity analysis, 143–149
 - simulation runs for, 122–134
 - specialization vs., 119–121
 - technical progress and, 116–119
 - theories on, 96–101
 - variables and parameters in models of, 137–143
- “zero quality” molecules
 - drug development and, 164–168,
 - pharmaceutical history-friendly simulation runs, 178–188