Index

3+2 scheme 50, 249–50, 420

A Coruña University 390
Aarhus Universitet 106, 254
Abbott, M. 155
Aberdeen University 54, 106, 127, 315
academic entrepreneurship 117, 118–19
academic promotion, rules for, in Italy 255–62
academic senate 245, 377
academic staff
Aquameth/CHINC definitions relating to 439–40
career structures for non-teaching staff 418
composition in Italian universities 246
composition in Spanish universities 391–5, 400–401
differences in number of 35
evolution in Portuguese universities 356–9
expenditure on 282, 321, 322, 323
female 391–3, 400–401
growth in number of 33, 34, 35–6, 357
national accreditation obtained by 377
number in UK universities 317, 320, 327, 328, 329, 330
full-time and part-time 317, 320, 327, 328, 329, 330
full-time research only 317, 321, 327, 328, 329, 330
full-time teaching and research 317, 321, 327, 328, 329, 331
and research productivity 331, 332, 334–5, 345
scientists per support staff 317, 321
per professor in Swiss universities 277, 279, 282, 283–4, 285, 286–7, 297
per undergraduate student, as Aquameth/CHINC indicator 423
as a percentage of total staff by discipline 281
publications per unit of 32, 37, 38, 48–55, 72, 366, 367, 369–70
qualifications of 365–6
ratio of technical and administrative staff to 393, 394
ratio of total expenses per head in Portuguese universities 363, 364, 367–8
selection and promotion of 75, 77, 78, 255–62
in top 20 universities by absolute number of international publications 52, 54
in top 20 universities in terms of PhD recipients 42–5
working conditions in Spain 382–3
accountability 347, 371
Açores University 349, 368, 369, 370
Adams, J.D. 153, 154, 323, 324, 337
age of universities
distribution of 33–7
and efficiency 160–61, 370
and indicators produced for Aquameth database 427
and offering profile 56
in Portugal 35, 348–9
and research orientation 75–6
and research productivity 330, 332, 345
in Spain 35, 376, 385, 388, 389–90
in UK 35, 314–16, 427
aggregate data, limitations of 23–4, 31
Aghion, P. 26
Alcalá University 390
Alesina, A. 79
Algarve University 174, 349, 367–9, 370
Alicante University 389
allocative efficiency 145
Almeria University 58, 389
Altbach, P.G. 7, 50
Amaral, A. 9, 86, 100, 211, 212, 349, 352, 354, 425
Andrew, L. 92
Aquameth database 22, 86, 124, 150
comparability and interpretation issues 423–9
coverage 408, 433–4, 442
data availability and issues 413–23
data construction and collection 406–13
findings on funding 253
limitations of 179–80, 269
deso-level data used in 405, 429–31, 433
third mission data collected in 122, 138
Aquameth 2 project 180, 181, 408, 431
architecture, specialization in 225
Arnold, E. 132
art colleges 307
Arvanitis, S. 216, 236
assistant professors 356–8
associate professors 356–8, 386, 391, 392
Associazione Trelle 260
Attar, L. 212, 215, 228, 236
Australia 155
Austria 91, 136
Autonoma Barcelona University descriptive statistics and indicators 43, 52, 389
PhD recipients 43
publications by 52
reputation in research 75
sources of funding 68, 71
Autonoma Madrid University age of 42, 390
descriptive statistics and indicators 43, 52, 390
PhD intensity and research efficiency in 174
PhD recipients 43
publications by 47, 48, 52
reputation in research 75
sources of funding 68, 71
autonomy, university 32, 63–72
and structural constraints in the Italian system see Italy
autoregressive distributed lag (ADL) model 324
Aveiro University 349, 368, 369, 370
average cost per undergraduate student in Swiss universities 278, 279
domain of specialization and 278–87, 297
Avveduto, S. 259
Azoulay, P. 176
Balconi, M. 136, 176
Balderston, F.E. 9
Baldini, N. 122, 136, 176
Baleares University 66, 68, 71, 389
Balestra, P. 299
Bangor, University of Wales 160
Barca, F. 260
Barcelona University age of 35, 389
changes in offering profile of 58
descriptive statistics and indicators 42, 52, 389
PhD recipients 41, 42
publications by 47, 48, 52
Bari Politecnico 68, 70
Bari University 58
Barr, N. 85, 92
Barré, R. 431
Barreto, A. 351
Basel University academic staff per professor in 279, 283, 284
average costs per undergraduate student in 279, 280, 283, 284, 287
average labour price in 279, 283, 284
curriculum 233
descriptive statistics and indicators 43, 44, 52, 275, 279
domains of specialization 225, 226, 274, 275, 280
evolution of expenditures and number of students in 289
floor space in 279, 283, 284
governance of 228–9
internal organization of 230
PhD degrees per 100 undergraduate students in 279, 283, 284
PhD intensity and research efficiency in 174
PhD recipients 43, 44
publications by 52, 279
ratio of PhD recipients to
undergraduate degrees 44
sources of funding 127
students per professor in 278, 279,
283, 284
undergraduate students in 275, 279,
283, 284, 289
Basque Country University 390
Bath Spa University College 128
Bath University 61, 62
Baumol, W. 292
Bayh–Dole Act (1980) 114, 175
Beasley, J.E. 168
Becher, T. 213
Beira Interior University (UBI) 174,
349, 368, 369, 370
benchmarking 443–57
power benchmarking (PB) 447–56
advantages of 447
benchmarking extreme
observations 453–6
high- and low-performing peers
448–50
histograms and power
benchmarks 452–3
mathematical appendix 460–62
measure of performance 450–52
questions and answers on 458–9
specifying mission and operating
environment 448
traditional benchmarking 444–7
university benchmarker (TUB)
456–7
uses 443
Benner, M. 115
Benninghoff, M. 86, 87, 89, 90, 91, 92,
221
Bergamo University 61, 62, 253
Bergen University 137, 157
Bern University
academic staff per professor in 279,
283, 284
average costs per undergraduate
student in 279, 280, 283, 284,
297
average labour price in 279, 284
curriculum 233
descriptive statistics and indicators
43, 44, 52, 275, 279
domains of specialization 225, 226,
274, 275, 280
evolution of expenditures and
number of students in 289
floor space in 279, 283, 284
internal organization of 230
PhD degrees per 100 undergraduate
students 279, 283, 284
PhD intensity and research efficiency
in 174
PhD recipients 43, 44
publications by 52, 279
students per professor in 279, 283,
284
undergraduate students in 275, 279,
283, 284, 289
Berner Fachhochschule 226
best practice 445–7, 449, 450
binary systems 5, 73, 347, 349
biotechnology 114, 119, 120, 136
Birkbeck College 61, 62
Birkeland, Kristian 118
Birmingham University
descriptive statistics and indicators
42, 45, 54
PhD recipients 41, 42, 45
PhD students in 38, 39
publications by 54
ratio of PhD students to
undergraduate degrees 44
total staff employed 160
Birnbaum, R. 9
Bjordal, T. 296
board of directors 245
Boeri, T. 260
Boezerooy, P. 90, 212
Bogetoft, P. 457
Bok, D.C. 79, 117, 175, 176
Bologna process 15, 76, 167, 171, 224,
232, 242–3, 249, 262, 263, 377,
420, 421
Bologna University 41, 43, 48, 52
Bolzano University 59, 60, 62
Bonaccorsi, A. 13, 20, 37, 122, 127,
146, 154, 156, 176, 178, 259, 260,
273, 337, 427
books, cost of reproduction of 34
Bournemouth University 68
Bowen, W.G. 9
Brandi, M.C. 259
Braun, D. 91, 210, 211
Breitzman, A. 79
Breno, E. 259, 269
Breschi, S. 176
Brescia University 53, 68, 71, 75, 253
Brighton University 69
Brinkman, P.T. 154
Bristol University 43, 54, 127, 160
Brno, Technical University of 254
Brubacher, J.S. 173
Brunello, G. 6, 262
Buckingham University 308
Burgos University 58, 390
Cadiz University 389
Cagliari University 68, 71, 253
Calderini, M. 176
California, State of 4
California, University of 8
Cambridge University
  age of 35, 307, 315
  descriptive statistics and indicators  42, 44, 54
  entrance test for 309
  PhD recipients 41, 42, 44
  PhD students in 38, 39
  publications by 47, 54
  ratio of PhD recipients to undergraduate degrees 44
  sources of funding 105, 106, 127, 254
  total staff employed 160
Cameron, R. 34
Cantabria University 389
Catholic University 350
Caves, D.W. 295
Cazals, C. 147, 148, 187, 424
Central England in Birmingham, University of 69
Central Lancashire, University of 128
Centre for Science and Technology Studies (CWTS) 313, 411
České vysoke učení technické v Praze 106, 254
CEST (Centre d’Études sur la Science et la Technologies) 216, 234, 236, 278, 304, 412
Chaffee, E.E. 8
Chambers, R.G. 299
Chariots, 88, 129, 309, 311, 316, 331, 437
Charnes, A. 149, 186
Checchi, D. 261
chemistry, patents in field of 135, 136
Chevaillier, T. 10
Chichester University, West Sussex 128
CHINC project 65, 86, 215
comparability and interpretation issues 423–9
coverage 408, 433–4, 442
data availability and issues 413–23
subjects offered by 232, 233, 234
third-mission activities by 236
capacity utilization, economies of, in Swiss universities 273, 295, 296, 298
Capano, G. 255
capital expenditure 321, 322, 416, 423
Cappellari, L. 6, 262
Caracostas, P. 91
Cardiff University 54
Carlos III Madrid University
  age and basic data 390
  changes in offering profile of 58
  growth rate of 61, 62
  reputation in research 75
  sources of funding 68, 70, 71
Carmichael, H.L. 261
Cartter, A.M. 172
Castilla Mancha University 58, 174, 389
Catania University 68, 71, 253
Catanzaro University 53, 58, 75
Catholic University 350
Caves, D.W. 295
Cazals, C. 147, 148, 187, 424
CCU 383, 385
Central Lancashire, University of 128
Centre for Science and Technology Studies (CWTS) 313, 411
České vysoke učení technické v Praze 106, 254
CEST (Centre d’Études sur la Science et la Technologies) 216, 234, 236, 278, 304, 412
Chaffee, E.E. 8
Chambers, R.G. 299
charities 88, 129, 309, 311, 316, 331, 437
Charnes, A. 149, 186
Checchi, D. 261
chemistry, patents in field of 135, 136
Chevaillier, T. 10
Chichester University, West Sussex 128
CHINC project 65, 86, 215
comparability and interpretation issues 423–9
coverage 408, 433–4, 442
data availability and issues 413–23
data construction and collection 407–13
findings on funding 15, 251, 253–4
meso-level data used in 405, 429–31, 433
purpose of 96–7
third mission data collected in 122
Christensen, L.R. 295
citations 38, 180, 387–8
City University 61, 62, 68, 70
CIVR see National Committee for the Evaluation of Research (Comitato di Indirizzo a Valutazione della Ricerca: CIVR)
Clark, B.R. 4, 7, 8, 79, 115, 116, 118, 119, 139, 175, 210, 211, 245, 425
class size 297
CNR (Consiglio Nazionale delle Ricerche) 426
CNRS (centre national de la recherche scientifique) 426
CNSU see National Council of University Students (Consiglio Nazionale degli Studenti Universitari: CNSU)
CNVSU see National Committee for the Assessment of the University System (Comitato Nazionale di Valutazione del Sistema Universitario: CNVSU)
Cobb–Douglas production function 323
Coelli, T.J. 337
Cohen, M.D. 10, 14, 213
Cohen, W.M. 114, 125, 133
Cohendet, P. 26
Cohn, E. 154, 299
Coimbra University 35, 348, 349, 368, 369, 370
Cole, S. 155
colleges, definition of 4
collegial bodies 377
Comi, S. 262
commercial products, academic faculty members involved in 130–33
commercialization
measurement of 119–23
see also science-directed commercialization; user-directed commercialization
Commission Fédérale des HES 229
communication sciences, specialization in 225
community colleges 4
competition between universities 7–8, 15–17, 79
complementarities 12–13, 24, 145–6
between R&D carried out at different periods of time 324
between teaching and research 165–72
between third-mission activities and basic research 175–9
Complutense Madrid University age of 35, 390
descriptive statistics and indicators 42, 52, 390
economies of scale in teaching in 157, 158, 159
PhD recipients 41, 42
PhD students in 38, 39
publications by 47, 48, 52
conditional efficiency 148–50, 165, 167, 168, 170, 177, 189, 191, 192
Confédération Suisse 214, 217, 232
Conférence des Rectors of Italian Universities (CRUI) 171, 187, 243, 247, 248, 262, 267, 268, 269, 409, 411
Conférence des Rectors of Swiss Universities (CRUS) 220, 224
Conference of UASs 220
Conférence Universitaire Suisse 216, 298, 299
conflicts of interest 119
Conraths, B. 95
consensual coordination 224
consultancy 117, 121, 130–33, 381, 437
Cordoba University 389
Corinnes, R. 299
corporate strategy 22
cost efficiency 272
cost functions 166
estimation of a variable cost function for Swiss Universities 288–94
cost indicators 277
cost minimization assumption 291
cost-sharing 371
cost structure of Swiss universities see Switzerland
Coupé, T. 114
Cowing, T.G. 300
Crespi, G. 323, 324
critical mass effects 20, 155
CRUE 381, 383, 387, 412
CRUI see Conference of Rectors of Italian Universities (CRUI)
CRUS see Conference of Rectors of Swiss Universities (CRUS)
CSIC (Consejo Superior de Investigaciones Científicas) 426
current expenditure to total expenditure ratio 423
curse of dimensionality 147, 149, 189
CWTS see Centre for Science and Technology Studies (CWTS)
Czech Republic
changes in tertiary education expenditure over time 101
CHINC data availability for 414, 417
CHINC data sources for 410
CHINC project covering 408, 433
number of institutions in CHINC sample 442
sources of funding in 93, 103, 106
Danish Centre for Studies in Research and Research Policy 410
Daouia, A. 163
Daraio, C. 13, 20, 146, 147, 148, 149, 156, 180, 187, 189, 190, 191, 192, 259, 273, 337, 424, 429
data envelopment analysis (DEA) 147, 149, 186–7, 189
David, P.A. 175
Davies, B. 154
De Fraja, G. 21, 166
De Francesco, C. 242
de Groot, H. 154, 299
Debreu, G. 186
decision-making unit (DMU) 150, 186
dedicated resources 17
degrees see Master’s degrees; PhD recipients; university degrees
Del Rey, E. 166
delegation schemes 21
democratization 377, 383–4
demographic factors, importance of 36–7
Denmark
academic patents in 136
changes in tertiary education expenditure over time 101
CHINC data sources on 410
CHINC project covering 408, 433
number of institutions in CHINC sample 442
sources of funding in 90, 93, 106
tertiary education expenditure as a percentage of GDP 100, 101
Département Fédéral de l’Intérieur 225
Department of Trade and Industry (DTI) 89
departments, role of, in Italian universities 246
Deprins, D. 149
Dewatripont, M. 21, 166
DGES (Directorate on Higher Education, Ministry of Science and HE) 411
Diamond, N. 5, 176
differentiation 4–8
horizontal 4–5, 7, 14
patterns in Swiss higher education system 209–38
policy implications 72–8
specialization and 17–18
and trade-off between teaching and research 167–8, 169–70, 171
vertical 5–6, 7, 14, 18, 51
diploma universitario 243
disciplinary differences 213–14
distributed lag models 324
Doucouliagos, C. 155
dropout rates 39, 242–3, 245, 263, 361, 362
DTI see Department of Trade and Industry (DTI)
dual higher education systems 5, 73, 120, 211–12, 425
Duderstadt, J.J. 8, 79
dummy variables 428
Dundar, H. 288
Dundee University 61, 62, 68, 127
duration of university studies 242–3, 245, 263, 359, 385, 420, 421
Dyson, R.G. 429
Index

écoles polytechniques 40–41
Economic and Social Research Council (ESRC) 311, 312–13
economics, specialization in 70–71, 75, 225, 282, 352
economics of capacity utilization in Swiss universities 273, 295, 296, 298
economies of scale 13, 153–65
in American universities 290
critical mass effect and 20, 155
in joint production of education and research 152, 165
in research 53, 151, 155–6, 162–4
in teaching 151, 156–62
economies of scope 13, 20, 272
in American universities 290
in research in UK universities 330, 334, 335
in Swiss universities 295–6, 298
Edinburgh University
age of 35, 315
descriptive statistics and indicators 42, 45, 54
PhD recipients 41, 42, 45
publications by 47, 48, 54
sources of funding 127
total staff employed 160
education production
data collected by Aquameth/CHINC 408, 410–12, 420–21, 434, 435, 440–42
indicators used by Aquameth/CHINC 423
see also university degrees
educational profile see offering profile
Ehrenberg, R.G. 26, 260
Eisenberg, R.S. 175
emergent strategies 6, 14, 72, 76, 77
Enders, J. 77
engineering
evolution of enrolments in 352
specialization in 57, 58, 59, 70, 71, 75, 368–9
ENIP see European Network of Indicator Producers (ENIP)
entrepreneurial universities 116–19, 138–9, 175
entry requirements 231, 308–9
EPFL (Federal Institute of Technology, Lausanne)
academic staff per professor in 279, 283, 284
average costs per undergraduate student in 278, 279, 280, 281, 283, 284
average labour price in 279, 283, 284
creation of (1969) 219–20, 223, 226
curriculum 233
descriptive statistics and indicators 44, 52, 275, 279
domains of specialization 226, 275, 280, 281
floor space in 279, 283, 284
internal organization of 229, 230
PhD degrees per 100 undergraduate students 279, 283, 284
PhD intensity and research efficiency in 174
PhD recipients 44
publications by 52, 236, 279
ratio of PhD degrees to undergraduate degrees 44
reputation in research 75
sources of funding 71, 106, 221, 254
students per professor in 279, 283, 284
undergraduate students in 275, 279, 283, 284
EPUL 220
ESRC see Economic and Social Research Council (ESRC)
Esterle, L. 409, 431
ESTIP see European Science and Technology Indicators Platform (ESTIP)
ETHZ (Federal Institute of Technology, Zurich)
academic staff per professor in 279, 283, 284
average costs per undergraduate student in 277, 280, 281, 283, 284
average labour price in 279, 283, 284
creation of (1854) 219, 226
curriculum 233, 280, 287
descriptive statistics and indicators 43, 44, 52, 275, 279
domains of specialization 226, 275, 280, 281
economies of scale in teaching in 157
floor space in 279, 283, 284
internal organization of 230
PhD degrees per 100 undergraduate students 278, 279
PhD intensity and research efficiency in 174
PhD recipients 43, 44
publications by 52, 279
ratio of PhD degrees to undergraduate degrees 44
sources of funding 71, 221
students per professor in 279, 283, 284
studies on strategies and organization of 215
undergraduate students in 275, 279, 283, 284
Etzkowitz, H. 113, 114, 115, 116, 118, 119, 175, 176
European Commission 65, 97, 259, 407
European Framework Programmes 222
European Higher Education Act (EHEA) 381, 382
European Network of Indicator Producers (ENIP) 65, 417, 430
European Research Area 425
European Science and Technology Indicators Platform (ESTIP) 430
European Social Fund 354
European Space Agency 91
European Union funds
access to 380
allocation of 354
growth in 316, 318, 397
included in Aquameth/CHINC database 436
share in total funding 66, 91, 252, 254, 319, 331, 355–6, 396
and research productivity 332, 335, 336, 346
Eurostat 409, 430
Evidence Ltd 313
Évora University 349, 368, 369, 370
excess capacity 296, 298
expenditures
data collected by Aquameth/CHINC 408, 409, 410–12, 413–16, 434, 435, 438–9
indicators used by Aquameth/CHINC 423
externality index 150, 189, 192
Extremadura University 390
Fachhochschule Nordwestschweiz 226
Fachhochschule Ostschweiz 227
Fachhochschule Zentralschweiz 227
Fachhochschulen 97, 120, 226–7, 424, 425, 439
faculties, role of, in Italian universities 246
Fairweather, J.S. 116
Färe–Lovell measure 450–51
Farrell, M.J. 149, 186, 451–2
Farrell measure of output-orientated efficiency 186, 187–8, 451–2
Farsi, M. 299, 300
federal countries
governance of HEIs in 211, 224, 425
regional funding in 436
federal institutes of technology (FITs)
average costs in 278, 279
by discipline 278, 280–81, 287
domains of specialization 225–8, 237, 274
costs related to 278, 280–81, 287
entry requirements for students 231
funding of 221, 222, 224, 274
governance of 216, 218, 219–20, 223, 228, 237
internal organization of 229–31
research quality in 236
subjects offered by 232, 233, 234
third-mission activities by 236
see also EPFL (Federal Institute of Technology, Lausanne; ETHZ (Federal Institute of Technology, Zurich)
fees see tuition fees
female staff 391–4, 400–401
female students 388, 391
Ferrara University 53
Figlio, D.N. 180
Filippini, M. 299, 300
Finland 136, 211–12
Index

Finocchi, R. 255
Firenze University 47, 48, 52, 174, 251
fixed effects (LSDV) model 293
floor space
in Spanish universities 387
in Swiss universities 278, 279, 283–4
and variable cost 292, 293–4
Florens, J.P. 189
Florida, R. 114, 133
Foggia University 68, 71
Fondo Finanziamento Ordinario (FFO) 250, 251, 269
Foray, D. 175
foreigners, universities for 241
forum shopping 263
Fox, M.F. 79
France
Aquameth 2 covering 180, 408
changes in tertiary education expenditure over time 101
CHINC data availability for 413, 414, 417
CHINC data sources for 409, 410, 413
CHINC project covering 408, 433
number of institutions in CHINC sample 442
Public Research Organizations in 426
sources of funding in 65, 91, 93
tertiary education expenditure as a percentage of GDP 100, 101
Franzoni, C. 176
Frascati manual 23, 24, 56, 145, 277, 417, 438, 439, 440, 441
free disposal hull (FDH) 149, 162, 186–7, 189, 191
Freeland, R.M. 9
Fribourg University
academic staff per professor in 279, 283, 284
average cost per undergraduate student in 278, 279, 280, 283, 284
average labour price in 279, 283, 284
curriculum 233, 280, 287
descriptive statistics and indicators 275, 279
domains of specialization 225, 226, 275, 280
floor space in 279, 283, 284
internal organization of 230
PhD degrees per 100 undergraduate students 278, 279, 283, 284
publications by 279
sources of funding 68, 128
students per professor in 279, 283, 284
undergraduate students in 275, 279, 283, 284
functioning expenses in UK universities 321, 322
funding, higher education
allocation mechanisms and national differences 86–92
changes in overall level over time 91, 95, 101–3, 108–9
changing models and patterns of 85–109
competition for 7–8, 15–17
data collected by Aquameth/CHINC 408, 410–12, 414–15, 416–17, 434–7
indicators used by Aquameth/CHINC 423, 427
internal allocation of 21, 22, 87, 166, 228, 229, 238, 249, 250, 255, 287–8, 289, 298, 320–23, 354, 396–8
Italian system 247, 255, 262
as a percentage of GDP for various European countries 100–101
Spanish system 380–81, 396
strategy and 9–10
UK system 309–11
see also European Union funds; general government allocations; government funding; grants and contracts; industrial funding; private funding; tuition fees
Further and Higher Education Act (1992) 308
fuzzy peers 453, 455–6, 458, 462

Andrea Bonaccorsi and Cinzia Daraio - 9781847206848
Downloaded from Elgar Online at 05/28/2019 01:53:19PM via free access
Gagliarducci, S. 260
Garcia-Aracil, A. 376, 381
Gardner, D.P. 4
Gary-Bobo, R.J. 6
Gattullo, M. 255
Gautier, A. 21, 166
Geiger, R.L. 5, 79
general government allocations 87–8, 89–90
Aquameth/CHINC data availability on 414–15, 417
Aquameth/CHINC definitions of overview in CHINC countries 93–5
for Portuguese universities 353–4, 355, 356, 371
as share of funding 96, 103, 104, 109, 317, 320, 355, 356, 371
as Aquameth/CHINC indicator 423
generalist universities change to/from specialist 57–9, 73, 228, 296, 298
definition of 428–9
efficiency models estimated for 151
features of 56
reputation of 75
research productivity of 334
sources of funding for 70, 71
in Spain 385, 389–90
in Switzerland 225–8
in UK 315, 334
generic technology disciplines 118–19
Geneva University academic staff per professor in 279, 283, 284
average costs per undergraduate student in 279, 280, 283, 284, 297
average labour price in 279, 283, 284
curriculum 233
descriptive statistics and indicators 45, 52, 275, 279
domains of specialization 225, 226, 274, 275, 280
evolution of expenditures and number of students in 289
floor space in 279, 283, 284
internal organization of 229, 230
PhD degrees per undergraduate students 279, 283, 284
PhD recipients 45
publications by 52, 279
ratio of PhD recipients to undergraduate degrees 44
sources of funding 127
students per professor in 279, 283, 284
undergraduate students in 275, 279, 283, 284, 289
Genova University 52, 228–9
Georgescu-Roegen, N. 26
Germany changes in tertiary education expenditure over time 101
CHINC data availability for 415, 417
CHINC data sources for 409, 410
competition for funding in 7–8, 15
dual education system in 120, 211–12, 425
number of institutions in CHINC sample 442
public research organizations in 426
social welfare benefits for students in 420
sources of funding in 65, 89, 92, 93, 103, 106, 251, 253
tertiary education expenditure as a percentage of GDP 100, 101
Getz, M. 154
Geuna, A. 79, 85, 86, 90, 91, 113, 114, 115, 132, 133, 310, 323, 324
Gibbons, M. 115
Giglioli, P.P. 245, 249, 256
Gingras, Y. 115, 118, 123
Girona University 389
Glaeser, E.L. 79
Glasgow University 35, 54, 127, 160, 315
Glass, J.C. 154
Godin, B. 23, 115, 118, 123, 133, 413
Goedegebuure, L. 350
governance system data availability affected by 413
and indicators produced from the Aquameth database 424, 425
Italian HEIs 245–8
Spanish HEIs 380–84
Swiss HEIs 210–13, 217–20, 223–5, 228–9, 237, 274

government funding

for Spanish universities 380, 396, 397, 401
for UK universities 103, 109, 316–17, 318–20

see also general government allocations; grants and contracts

graduate schools 78

graduated students see university degrees

Graham, H.D. 5, 176
Granada University 35, 158, 174, 389
grandes écoles 6
Granelli, A. 260

grants and contracts

Aquameth/CHINC data availability on 414–15, 417
Aquameth/CHINC definitions of 435–7
to FITs 221
HEFC block grants 309, 310
international 436, 437

see also European Union funds
as share of funding 96, 104–8, 254, 396, 397
as Aquameth/CHINC indicator 422, 423
as user-directed commercialization 117, 120, 121, 125, 137
Greene, W.H. 299, 338
Griliches, Z. 153, 154, 323, 324, 337, 405
Grossman, G.M. 5, 18
Groupe de projet ‘Paysage des Hautes Écoles 2008’ 273
Guellac, D. 324
Gulbrandsen, M. 115, 118, 119, 123, 138, 139
Gumport, P. 9
Guri-Rosenblit, S. 212
Guyomard, H. 300

Halsey, A.H. 155
Hamilton, K.S. 154, 176
Hare, P. 154
Harman, G. 155
Harmon, L. 172
harmonization of accounting systems 216
harmonization of educational systems 242
Haute École Spécialisée de Suisse Occidentale 226
HE colleges 307–8
health sciences 137, 352–3, 360, 364–5
Hearn, J.C. 8
Heller, M.A. 175
Hellström, T. 115
Helpman, E. 5, 18
Henderson, J. 176
Henderson, R. 114
Henkel, M. 10
Henrekson, M. 117
Herbst, M. 215
heterogeneity of individual HEIs 424, 427
Hevert, K.T. 154
Hicks, D. 38, 176, 277, 419
high-performing peers 449–50, 456
dominance and distance measures for 460–61
fuzzy 455–6, 458, 462
mathematical definition of 460
ranking of 450–53
scaled 454, 455, 458, 461–2
strict 453, 455, 458
Higher Education Funding Councils (HEFC) 125, 309, 310
Higher Education Statistical Agency (HESA) 412
Hirschman, A.O. 262
histograms and power benchmarks 452–3
hogescholen 97, 104, 120, 212, 425, 439
Holtmann, A.G. 300
Homerton College 60
horizontal differentiation 4–5, 7, 14
hospitals, university expenditures on 416, 428, 438
Portuguese public universities with 349
and productivity in the UK 330, 332, 335, 345
revenues for medical services of 434
Spanish universities with 385, 388, 389–90
Hsiao, C. 299
Huelva University 58, 389
Huisman, J. 97, 211, 212, 235, 425
Hull University 60, 62
human capital, investment in 13
human and social sciences
costs related to 280, 281, 282, 283, 285, 295, 297, 369–70
doctoral degrees awarded in 360
evolution of expenditures and number of students in 289
evolution of number of undergraduate students in 287, 288, 352–3
measuring scientific production in 38, 313
percentage of higher education students in 388, 391
publications in 364, 365
specialization in 56, 57, 58, 225, 226–7, 275, 276, 331, 332, 334, 335–6, 345, 369–70, 385, 388, 389–90
Humboldtian model 5, 167, 298
Hungary
Aquameth 2 covering 180, 408
changes in tertiary education expenditure over time 101
CHINC data availability for 415
CHINC data sources for 409, 411
CHINC project covering 408, 433
number of institutions in CHINC sample 442
sources of funding in 94
tertiary education expenditure as a percentage of GDP 100, 101
hypothesis testing 429
Ichino, P. 256, 260
Imperial College of Science, Technology and Medicine
attempted merger with University College 155
descriptive statistics and indicators 42, 44, 54
PhD recipients 41, 42
publications by 47, 53, 54
ratio of PhD recipients to undergraduate degrees 44
sources of funding 68, 70, 71, 105, 106, 127, 254
total staff employed 160
incubators and accelerators 244–5
indicators used in Aquameth/CHINC projects
comparability and interpretation issues 423–9
construction of 421–3
individual index 150, 189, 192
industrial dynamics of universities 32–7
industrial funding 64
and commercial results 130, 132, 133
effect on basic research 177–9
for Italian universities 253
for UK universities 309, 316
industrial organization of the higher education system 19–21
INE 380, 385
informatics, specialization in 225
information asymmetry 20–21
informed peer review 310
INRA 426
INSERM 426–7
Institute for information on education (UIV) 410
Institute for Prospective Technological Studies (IPTS) 65, 97
Institute of Education 44, 61
institutional positioning 237, 406
institutional rigidities 7, 9, 15, 74–5, 76–7
Instituto Superior de Ciências do Trabalho e da Empresa (ISCTE) 68, 70, 349, 368, 369–70
instruments, patents in field of 135, 136
Insubria University 53, 61, 62, 75, 253
interdependence of decisions 11–12
interdisciplinarity 229
interim professors 386
international mobility of students 16, 51, 77
Iossa, E. 21, 166
Irás os Montes e Alte Douro (UTAD)
349, 368, 369, 370
Ireland 136
irreversibility 11–12, 13
Irvine, J. 90
ISCTE see Instituto Superior de Ciências do Trabalho e da Empresa (ISCTE)
Italy
3+2 system in 50, 249–50, 420
academic patents in 136
age of universities in 35
Aquameth/CHINC data availability for 415, 417, 418
Aquameth/CHINC data sources for 409, 411
Aquameth database covering 408, 433
changes in offering profile of universities in 58
changes in tertiary education expenditure over time 101
economies of scale in teaching in 157–9
evaluation system for universities in 243–4, 247–8, 264
evolution of number of universities in 241, 242
funding mechanism in 247, 255, 262
government policy in 62
growth rate of universities in 59, 60, 61, 62
number of graduates in 171
number of institutions in Aquameth/CHINC sample 402
numbers of PhD recipients and students in 39, 40, 41, 43, 44, 46–7, 55, 72
postgraduate education system in 173, 174
public research organizations in 426
publications by universities in 47, 48, 49, 51, 52, 53, 55
reforms in higher education system since 1989 in 241–5
sources of funding in 65, 66, 67–70, 71, 91, 94, 104, 250–55
teaching load in 50, 72
technical efficiency in joint production of education and research in 165
technical efficiency in research in 162–3, 174
tertiary education expenditure as a percentage of GDP 101
third mission role of universities accepted in 244–5
trade-off between research intensity and teaching efficiency in 168, 170
trade-off between third-mission activities and research in 177–9
university autonomy and structural constraints in 241–64
adaptation of university system to reform process 249–50
conclusions 262–4
governance of the system 245–8
legislative framework and some recent reforms 241–5
managing tension between strategic autonomy and institutional constraints 250–55
quantitative data on the Italian university system 267–71
rules for academic promotion 255–62
university-dominated higher education system in 73, 263
Iverson, E. 140
Jaen University 58, 389
Jaffe, A.B. 175, 336
Jaume I University 58, 389
Jencks, C. 4, 5, 50
Johansen, F. 324
Johnes, G. 147, 155
Johnston, R. 153, 154, 155
Jongbloed, B. 10, 37, 85, 86, 87, 90, 235, 272, 276, 277, 297, 418
Journal of Econometrics 25
Kaiser, F. 86, 87, 92, 97, 212, 235, 273, 425
Keller, G. 8
Kennedy, P. 34
Kerr, C. 4, 7, 8
King, D.A. 49, 259, 372
King Alfred's College, Winchester 128
King's College London 43, 45, 54, 127, 160
Kleinman, D.L. 115
Klette, T. 324
Knorr-Cetina, K. 23
knowledge capital
and research productivity 331, 332, 334, 335, 345
specification of 323, 325, 331
knowledge production function, UK
see United Kingdom
knowledge spillovers 323, 336
Kogan, M. 4, 10
Koshal, M. 288, 290, 292
Koshal, R. 288, 290, 292
Kyvik, S. 4, 37, 73, 97, 212, 263, 406

labour price, average 279, 284
and variable cost 291, 293, 294
Laffont, J.J. 20
Laguna University 35, 389
Lampeter, University of Wales 60, 62
Lancaster University 61, 62
Langfeldt, L. 115
languages, specialization in 59, 70
LaPidus, J.P. 173
Larédo, P. 15, 23, 148, 425
Las Palmas University 58, 389
Lau, L.J. 291
laurea 243
Lausanne University
academic staff per professor in 279, 283, 284
average costs per undergraduate student in 279, 280, 283, 284, 297
average labour price in 279, 283, 284
changes in offering profile of 58 curriculum 233
descriptive statistics and indicators 44, 52, 275, 279
domains of specialization 225, 226, 238, 274, 275, 280
evolution of expenditure and number of students in 289
floor space in 279, 283, 284
governance of 228–9
internal organization of 229, 230
PhD degrees per 100 undergraduate students 279, 283, 284
PhD recipients 44
publications by 52, 279
ratio of PhD recipients to undergraduate degrees 44
students per professor in 279, 283, 284
undergraduate students in 275, 279, 283, 284, 289
law
admission to courses 309
specialization in 225, 352
Layard, P.R. 154
League of the European Research Universities (LERU) 26
Leeds Metropolitan University 128
Leeds University 43, 54, 160
Leicester University 54
length of university studies 242–3, 245, 263, 359, 385, 420, 421
Leon University 68, 71, 174, 390
Leresche, J.-P. 211, 214
Lerner, J. 175, 263
Leslie, L.L. 8, 79, 113, 154, 175
Leszczensky, M. 92
Lev, B. 324
Levin, G. 79
Levin, S. 260
Levinthal, D.A. 125
Lewis, D.R. 288
Ley de Ordenación Universitaria (LOU) (Spain, 2001) 377, 382, 384, 400
Ley de Reforma Universitaria (LRU) (Spain, 1983) 376–7, 400
Leydesdorff, L. 114, 115
libera Università 241
Libera Università Mediterranea Jean Monnet 60
libero Istituto 241
licensing 117, 118, 120, 121–2, 175, 236, 255
data collected by Aquameth/CHINC
412, 441
limited competition 10–11
Index

Linder, W. 217, 224
Lisboa University 348, 349, 368, 369, 370
Little, B. 10
Liverpool University 54, 160
Lleida University 389
Llerena, P. 26
Lloyd, P. 154
localization patterns 62–3
London
research productivity of universities in 332, 334, 345
university cluster in 315
London Business School 68, 70
London Institute 68, 70, 128
London School of Economics and Political Science 45, 68, 70
London School of Hygiene and Tropical Medicine 69, 70, 127
London South Bank University 68
loosely coupled systems 10, 213
Lotka’s equation 49, 50
low-performing peers 450
dominance and distance measures for 461
fuzzy 455
mathematical definition of 460
ranking of 451–3
scaled 454, 455, 462
strict 453, 455
Lowen, R.S. 79
Lugano University 275
Lundvall, B.-A. 114
Luzern University
academic staff per professor in 279, 283
average costs per undergraduate student in 279, 280, 281, 282, 283
average labour price in 279, 283
curriculum 233, 282
descriptive statistics and indicators 44, 275, 279
domains of specialization 225, 226, 275, 280
floor space in 279, 283
growth rate of 60
internal organization of 230
PhD degrees per 100 graduate students 279, 283
PhD recipients 44
publications by 279
ratio of PhD recipients to undergraduate degrees 44
sources of funding 68
students per professor in 279, 282, 283
undergraduate students in 275, 279, 283
Maassen, P. 26, 211
Macerata University 68, 253
Madeira University 349, 368, 369, 370
Madrid Politechnic see Technical University of Madrid
Malaga University 389
Manchester University
descriptive statistics and indicators 42, 45, 54
PhD recipients 41, 42, 45
publications by 54
ratio of PhD recipients to undergraduate degrees 45
total staff employed 160
March, J.G. 10, 14
marginal rates of substitution 12, 13
Marginson, S. 155
market-based systems 77, 86, 181
Marsh, L.C. 25
Martin, B.R. 79, 90, 115, 310
mass higher education, transition to 3–4, 16, 376, 378
Massachusetts Institute of Technology (MIT) 116
Master’s degrees
duration of 421
institutions offering 232, 359
in Italy 249–50, 253
in Netherlands 212
in Portugal 352, 358, 359, 421
as research output 324
Matthew effect 133
Max Planck Institute 426
Mayo, J.W. 292
McCormick, A.C. 422
McPherson, M.S. 261
medical schools 38, 56, 59, 127–8, 129, 349, 426, 428
medicine
admission to courses 309
average number of students in Swiss universities 297–8
costs related to 278–80, 281, 282, 284, 287, 295, 297, 298, 369
evolution of expenditures and of number of students in 288, 289
evolution of number of undergraduate students in 288
percentage of higher education students in 388, 391
specialization in 56, 57, 58, 75, 225, 226, 237, 274, 275, 276, 349, 369, 385, 388, 389–90
see also medical schools
Meek, V. L. 4, 155
mergers 155, 156
Merrien, F.-X. 210, 211
Merton, R. K. 133
meso-level data 405, 429–31, 433
Messina University 58, 61, 62, 158
Meyer, J. W. 9
Meyer, M. 119, 136, 176
Michigan, University of 8
microdata approach 23–4, 31, 145, 179
Miguel Hernandez University 60, 62, 390
Milano Bicocca University 58, 60, 62
Milano Politecnico 69, 70, 71, 241, 251
Milano San Raffaele University 60, 62
Milano University 47, 48, 52, 53, 174
Millar, J. 220
Minho University 349, 368, 369, 370
ministries, Swiss 219
Ministry for Education (UK) 309
Ministry for Education, University and Research (Ministero dell’Istruzione, dell’Università e della Ricerca: MIUR) 246, 248, 251, 255, 257, 267
Ministry for Science and Education (Portugal) 353
Ministry for Universities and Scientific and Technological Research (Ministero dell’Università e della Ricerca Scientifica e Tecnologica: MURST) 241–2, 246
Ministry of Economic Affairs (Netherlands) 411
Ministry of Education (Denmark) 410
Ministry of Education (Portugal) 352, 353, 409
Ministry of Education (Spain) 383
Ministry of Education and Research (Norway) 411
Mintzberg, H. 14
mission, benchmarking of 445, 447, 448, 449–50, 452, 458
Mode 1 knowledge 115
Mode 2 knowledge 115
Modena-Reggio Emilia University 251
Modena University 53
Moed, H. F. 38
Moguérou, P. 16
Molise University 68, 71
Mora, J. G. 376, 377, 380, 381, 383
Morrone, M. 26
Mowery, D. C. 114, 115, 117, 176
Muldur, U. 91
multi-layer models 429
multi-output units, strategy for 11–14
multidimensional mapping 25
multiple-stage approaches 148
Murcia University 390
music colleges 307
Mustain, P. 23, 119
Napoli Benincasa University 61, 62
Napoli Navale University 61, 62, 68, 70
Napoli II University 61, 62
Napoli University
descriptive statistics and indicators 4, 52
economies of scale in teaching in 158
PhD recipients 41, 43
PhD students in 39
publications by 47, 48, 52
Nardozzi, G. 260
Narin, F. 79, 154
National Committee for the Assessment of the University System (Comitato Nazionale di Valutazione del Sistema Universitario: CNVSU) 247, 248, 262, 267, 270–71, 409, 411
National Committee for the Evaluation of Research (Comitato di Indirizzo a Valutazione della Ricerca: CIVR) 247–8, 264, 267
Index

national correspondents 430
National Council of University Students (Consiglio Nazionale degli Studenti Universitari: CNSU) 247, 248
National Open University 390
National Prize for Innovation 244
National University Council (Consiglio Universitario Nazionale) 246, 248
National University Evaluation Council (Osservatorio per la valutazione del sistema universitario) 243–4
natural sciences
average number of students in Swiss universities 297
costs related to 278, 280, 281, 282–7, 295
doctoral degrees awarded in 360
evolution of expenditures and number of students in 288, 289
evolution of number of undergraduate students in 288, 352–3
percentage of higher education students in 388, 391
publications in 364, 365
specialization in 56, 225–8, 237, 274, 275, 276, 385, 388, 389–90
Neave, G. 10, 211, 425
Nederhof, A. 313
Nelson, R.R. 114, 115, 117, 154, 175, 288
Nerlove, M. 299
Nesta, L. 114, 115, 132, 133
Netherlands
Aquameth 2 covering 180, 408
changes in tertiary education expenditure over time 101
CHINC data availability for 415, 418
CHINC data sources on 411
CHINC project covering 408, 433
dual higher education system in 120, 212, 425
number of institutions in CHINC sample 442
sources of funding in 90, 94, 103, 104, 253
tertiary education expenditure as a percentage of GDP 101
Neuchâtel University
academic staff per professor in 279, 283
average costs per undergraduate student in 279, 280, 283
average labour price in 279, 283
curriculum 233, 280
descriptive statistics and indicators 45, 275, 279
domains of specialization 225, 226, 275, 280
floor space in 279, 283
internal organization of 230
PhD degrees per 100 undergraduate students 279, 283
PhD recipients 45
publications by 279
ratio of PhD recipients to undergraduate degrees 45
sources of funding 106
students per professor in 279, 283
undergraduate students in 275, 279, 283
Newcastle-upon-Tyne University 54, 160
Newman, F. 9
NIFU STEP 411
nonparametric efficiency analysis 13–14, 146, 147, 148–9, 179, 186–92, 424, 427, 429
non-PhD-awarding institutions 212, 228, 408, 420, 425, 434
non-profit organizations 123–4, 129, 136, 253, 414–15
non-state universities, in Italy 241, 242
Norges teknisk-naturvitenskapelige universitet 106
Norsk Hydro 118
Northumbria at Newcastle, University of 68, 128
Norway
academic patenting in 114
age of universities in 35
Aquameth/CHINC data availability for 415, 417
Aquameth/CHINC data sources for 409, 411
Aquameth database covering 408, 433
Aquameth 2 covering 181
binary education system in 73, 212
changes in tertiary education expenditure over time 101
measuring science-directed commercialization in 129–37, 138
number of institutions in Aquameth/CHINC samples 402
number of PhD recipients in 40, 41, 46–7, 55
publications by universities in 47, 48, 49, 50, 51, 52, 55
R&D allocation by sector in 124, 125
research contracts for PhD students in 418
sources of funding in 65, 66, 67, 94, 103, 106, 124–8, 251
tertiary education expenditure as a percentage of GDP 100, 101
Norwegian university census 129
Norwegian University of Science and Technology 128, 137
Nottingham Trent University 159
Nottingham University 43, 54, 160
Nova de Lisboa 349, 368, 369, 370
Nowotny, H. 113, 115, 116
nuclei di valutazione interna 243
OCES (Observatory on Science and HE, Ministry of Science and HE) 351, 374, 411
OECD see Organization for Economic Cooperation and Development (OECD)
offering profile 55–9
Office Fédéral de l’Education et de la Science 232
Office of Science and Technology (OST) 154, 311
Oliver, C. 9
Open University 4, 68, 70, 128, 157
operating environment 447, 448
order-m efficiency scores 149, 163, 187–92
order-m frontiers 147, 168, 170, 171, 172, 189, 191–2
ordinary least squares (OLS) 293, 314, 344
Organization for Economic Cooperation and Development (OECD) 16, 85, 91, 92, 100, 101, 114, 124, 212, 214, 277, 409, 417, 420, 428, 430, 441
Orléan, A. 26
Oslo manual 23, 145
Oslo University 52, 118, 137
OST see Office of Science and Technology (OST)
outliers 147, 187, 189, 191
output space 7, 18
Oviedo University 35, 389
Oxford University age of 35, 307, 315
descriptive statistics and indicators 42, 44, 54
entrance test for 309
PhD recipients 41, 42, 44
PhD students in 38, 39
publications by 47, 54
ratio of PhD recipients to undergraduate degrees 44
sources of funding 70, 71, 127
total staff employed 160
Pablo Olavide University 60, 62, 389
Padova University 47, 48, 52, 53, 251
Pais Vasco University 157, 158
Paletta, A. 248
Panzar, J.C. 295–6
parametric methods 146
Parma University 58
part-time staff 317, 320, 327, 328, 329, 330, 417
part-time students 420
participation rate in higher education 3–4
Pasteur’s quadrant 119
patenting 116, 117, 118, 120, 121, 122, 137, 139, 175
comparing across countries 136, 138
data collected by Aquameth/CHINC 410, 411, 412, 431, 441, 442
effect on basic research 175–7
legislation concerning 114, 175
Norwegian academic faculty members involved in 118, 129–37, 138
Patrucco, P.P. 79
Pavia University 52, 53, 253
peer reviews 310, 350
Perellon, J.-F. 211, 214
performance contracts 211, 221
Perotti, R. 260
personnel see academic staff; staff; technical and administrative staff
personnel expenditure to total expenditure ratio 423
personnel structure by discipline 281
Perugia Stranieri University 59, 60, 67–70
Pfeffer, J. 10
pharmaceuticals, patents in field of 135, 136, 139
pharmacy, specialization in 287
PhD recipients
Aquameth/CHINC definitions of number of 440
number of PhD degrees awarded by Portuguese universities 358–60
number of PhD degrees awarded by UK universities 328, 329
ratio of PhD degrees to undergraduate students
correlation between share of contracts and grants and 106–7, 108
inter-country comparisons 418
as a measure of research intensity 151, 168, 421–2
as a measure of research orientation 32, 37, 39–47, 55, 72
and research productivity 173–4
in Swiss universities 278, 279, 282, 283–4, 285, 286, 287, 297, 418
and teaching efficiency 168–70
PhD students
Aquameth/CHINC definition of number of 440, 442
fees paid by 88, 355
as input or output of knowledge production? 172–4, 407, 418–19
number in UK universities 327, 328, 329, 330, 331
as teaching assistants 166, 291, 297, 439
Piemonte Orientale University 75, 253
Pisa University 47, 48, 52, 53
PNI Cube 244–5
polynomial distributed lag (PDL) models 324
polytechnics
public polytechnics in Portugal 347, 348, 349, 350, 351, 359
transformation into universities in UK 62, 73, 307, 308, 315, 427
Pompeu Fabra University 75, 389
Porto University 348, 349, 368, 369, 370
Portugal
age of universities in 35, 348–9
Aquameth/CHINC data availability for 417
Aquameth/CHINC data sources for 409, 411
Aquameth database covering 408, 433
binary higher education system in 73, 347, 349
evaluation of research in 350–51
evaluation of undergraduate degrees in 350
evolution of enrolments in 351–3
growth rate of universities in 62
number of institutions in Aquameth/CHINC samples 442
numbers of PhD recipients and students in 39, 40, 41, 46–7, 72
postgraduate education system in 173, 174
private higher education institutions in 349–50, 351, 352, 359
public research organizations in 426
public university system in 347–72
behaviour of different universities 367–70
characterization of system 348–53
conclusion 370–72
evolution of financial resources 353–6
evolution of human resources 356–9
evolution of research productivity 364–7
evolution of teaching productivity 360–64
expanding teaching and research potential 359–60
introduction 347–8
publications by universities in 47, 48, 49, 364–70, 372
sources of funding in 66, 67, 68, 353–6, 371
teaching load in 50, 72
technical efficiency in joint production of education and research in 165
technical efficiency in research in 162–3, 173–4
postgraduates see PhD recipients; PhD students
power benchmarking (PB) see benchmarking
price/quality ratio 5–6, 63
PRIME Network of Excellence 65, 145, 431
private funding 88, 91, 96
Aquameth/CHINC data availability on 414–15, 417
Aquameth/CHINC definition of 437
average share by country 66, 107–8
effect on basic research 177–9
for Italian universities 66, 253–4
as a measure of user-directed commercialization 123–9, 137, 139
overview for CHINC countries 93–5
for Portuguese universities 66, 355, 356
for Spanish universities 66, 380–81, 396, 397, 401
for UK universities 66, 316, 317, 318, 319, 331
see also industrial funding
private higher education institutions and indicators produced from the Aquameth database 425–6
in Portugal 349–50, 351, 352, 359
in Spain 377, 378, 379, 383, 385
production factors, substitutability of 12–13, 24
production function 146–7
see also United Kingdom professional bodies 308
professional domains 213–14
professional education
Swiss in higher education see Universities of Applied Science (UAS)
outside higher education 238
UK 308
professor’s privilege 114
professors
Aquameth/CHINC definition of 439
expenditure on, by discipline 282
as a percentage of total staff 282, 391, 392
in Portuguese public universities 356–8
publications per professor 366, 367, 369–70
representation in collegial bodies 377
in Spanish universities 386, 391, 400
promotion see academic promotion, rules for, in Italy
public research organizations (PROs) 426–7
Public University of Navarra 390
publications see scientific publications
purchasing power parities (PPPs) 417, 422
Queen Mary and Westfield College 54, 127
Queen’s University of Belfast 54
radar charts 148
Ramsden, P. 79, 153, 155
random effects model (GLS) 293
Ravenscraft, D. 323
Reading University 54
rectors, role of, in Italian universities 245, 249
redbrick universities 307, 315
regional distribution of universities in Spain 377–8, 385, 389–90, 401
in UK 315
Reichlin, P. 260
Renaissance 34, 35
reputation 10, 50, 51, 74, 75, 213
Research Act (Switzerland, 1983) 222
Research Assessment Exercise (RAE) 90, 309–14
Aquameth/CHINC data collected from 412
data obtainable from 312
expected bias of using RAE research outputs 312–14, 327–30, 344
information on total research outputs provided by 335, 342
publications submitted in 47, 48, 53, 54, 152, 310–14, 326, 327–30, 335, 412
rating system in 309–11
research councils 91, 93, 94, 95, 125, 222, 250, 309, 311, 436, 437
research and development (R&D)
Aquameth/CHINC definition of expenditures on 438, 439
expenditure in Spanish universities 380
expenditure in UK universities 327, 328, 329, 330
internationalization of 15
lags in effect of expenditure on 323–4
proximity 15–16
share of time devoted to 439, 441
research efficiency, evidence on 162–3
research institutes 132, 135, 138, 229–31
research intensity
evidence relating to 47–55, 72
measurement of 32, 37, 38, 151, 168, 277–8, 421–2
in Swiss HEIs 235–6, 278, 279, 282, 283–4, 285, 286, 287, 295, 297
research orientation
evidence relating to 38–47, 55, 72
measurement of 32, 37
research outputs
categories of 306
data collected by Aquameth/CHINC 408, 410–12, 419–20, 434, 435, 441–2
indicators used by Aquameth/CHINC 423
measurement of 151, 312–14, 324–5, 327, 421, 422
research profile of universities 37–55, 72
age of university and 75–6
related to higher education
taxonomies 73
research universities 4, 5, 21, 50, 75, 241, 242
researchers, Aquameth/CHINC definition of 439, 440
Reskin, B.F. 155
revenues see funding
Rey Juan Carlos University 60, 62, 390
Rhoades, G. 115
Ridder Simoens, H. de 34
Riesman, D. 4, 5, 50
Rioja University 390
Rizzi, D. 244
Roberts, J. 26
robust indicators 422, 423
Roehampton University 128
Roma Campus biomedico University 60, 62, 68, 70, 75
Roma La Sapienza University 48, 52, 53
Roma LUMSA University 60, 62
Roma San Pio V University 60
Roma Tor Vergata University
descriptive statistics and indicators 52
growth rate of 61, 62
publications by 52
reputation in research 75
sources of funding 68, 71, 253
Roma Tre University 58, 60, 62, 251
Rose Bruford College 61
Rosenberg, N. 115, 117
Roskilde Universitet 106, 254
Rossi, S. 260
Rothblatt, S. 34
Rouvinen, P. 176
Rovira and Virgili University 389
Rowan, B. 9
Royal College of Art 128
Royal Veterinary College 61
Rudolph, F. 4
Rudy, W. 173
Ruegg, W. 34
Ruggiero, J. 148
St Andrews University 315
St Mary’s College 128
Salamanca University 35, 376, 388, 390
Salancik, G.R. 10
salaries, academic staff 382–3  
Salerno, C. 100, 147, 272, 276, 277, 297, 420  
Salford University 60, 62  
Sampat, B.N. 114, 176  
sample size bias 189  
Samuel Neaman Institute 4  
San Raffaele University 59, 75  
Sandström, U. 115  
Sanford, N. 4  
Sanks Gallen University  
academic staff per professor in 279, 283  
average costs per undergraduate student in 279, 280, 282, 283  
average labour price in 279, 283  
curriculum 233, 282  
descriptive statistics and indicators 44, 275, 279  
domains of specialization 225, 226, 275, 280  
floor space in 279, 283  
internal organization of 230  
PhD degrees per 100 undergraduate students 279, 283  
PhD recipients 44  
publications by 279  
ratio of PhD recipients to undergraduate degrees 44  
sources of funding 67, 68, 104, 126–7  
students per professor in 279, 282, 283  
undergraduate students in 275, 279, 283  
Sannio University 58, 61, 62, 68, 71  
Santiago Compostela University 52  
Santiago University 390  
Sarrio, C.S. 429  
Sassari University 251, 253  
Sav, G.T. 288, 290  
scale efficiency 272  
scaled peers 453, 454–5, 458, 461–2  
Scherer, F.M. 323  
Schimank, U. 167  
Schmoch, U. 136, 420  
School of Oriental and African Studies 45, 68, 70  
science-directed commercialization 117, 120  
as distinct from user-directed commercialization 117–18  
indicators of 121–2, 137  
measurement of 129–37  
science parks 139  
scientific publications  
absolute number per university 47–8, 51–5  
co-authorship academia – industry 120, 121  
co-authorship academia – PRO 426–7  
data collected by Aquameth/CHINC 410–12, 419, 441, 442  
efficiency and returns to scale in production of 151, 155–6, 162–4  
effects of scale on joint production of education and research 152, 165  
efficiency trade-off between teaching and research? 165–72  
and entrepreneurial outputs 132–3  
exenses per unit of 259, 260, 365–70  
as a measure of research intensity 32, 37, 38, 277  
inter-country differences 47–55  
as a measure of research output 151, 312–14, 421, 422  
required by research assessment exercise (RAE) 47, 48, 53, 54, 152, 310–14, 326, 327–30, 335, 412  
used as Aquameth/CHINC indicator 423  
PhD students as input or output of knowledge production? 172–4  
by Portuguese universities 47, 48, 49, 364–70, 372  
by Spanish universities 47, 48, 49, 51, 52, 53, 55, 387–8, 398, 399  
by Swiss universities 47, 48, 49, 50, 51, 52, 53, 55, 72, 234, 236, 278, 279  
trade-off between third-mission activities and 175–9  
by UK universities 47–8, 49, 50, 53–5, 72, 327, 328, 329, 330–36
Index

Scotland, university cluster in 315
Scott, P. 4
Scott, W.R. 9, 213
Secretary of State for Education and Skills 308
seed funding 117, 137
Senker, J. 220
Sevilla University 35, 43, 389
SFSO 303, 304
Shane, S. 176
Shangai league table 50
Shapiro, H.T. 9
Sheffield University 39, 43, 54, 159, 160
Shephard, R.W. 186
Shephard output distance function 186
short-run marginal cost by discipline 294–5
Siegel, D.S. 136
Siena Stranieri University 44, 59, 60, 67–70
Siena University 58, 253
Silvestri, P. 244
Simão, J.V. 351, 352
Simar, L. 13, 147, 148, 149, 163, 180, 187, 189, 190, 191, 192, 424, 429
Simone, R. 255
Siow, A. 260, 261
SIUS see Système d’Information Universitaire Suisse (SIUS)
size of universities
and academic staff per professor 282, 286–7, 297
and average costs 282, 287
determinants of growth in 59–63
distribution of 33–7
and offering profile 56
and PhD degrees per undergraduate student 282, 287
and scientific productivity 51–5, 331, 332, 334–5, 345
and students per professor 282, 286–7, 297
and technical efficiency 152, 156–65
Skovdjin, O.J. 212
Slaughter, S. 8, 79, 113, 115, 175
Slipersæter, S. 15, 98, 99, 122, 277, 278, 412, 429
Smeby, J.-C. 118, 123, 138, 139
Smidt, H. 95
social councils 377
Social Science Citation Index (SSCI) 38, 387
social sciences see human and social sciences
socio-economic factors 148, 180
Sorbonne Declaration (1998) 242, 243
Sougiannis, T. 324
Southampton University 43, 45, 54, 160
Spain
academic patents in 136
age of universities in 35, 376, 385, 388, 389–90
Aquameth/CHINC data availability for 415, 418
Aquameth/CHINC data sources for 409, 412
Aquameth database covering 408, 433
changes in offering profile of universities in 58
changes in tertiary education expenditure over time 101
composition of public universities’ expenditure in 396–7, 399, 401
composition of university staff in 391–5, 400–401
economies of scale in teaching in 158, 159
evaluation of higher education systems in 381–2
expansion and reorganization in the higher education system in 376–401
conclusions 400–401
institutional setting 376–80
mechanisms of governance 380–84
quantitative indicators 388–99
quantitative information 384–8
government policy in 62, 384
growth rate of universities in 60, 61, 62
number of higher education students in 378–80, 388–9, 393, 395, 400
number of institutions in
Aquameth/CHINC samples 442
numbers of PhD recipients and students in 39, 40, 41, 42, 43, 46–7, 55, 72
postgraduate education system in 173, 174
public research organizations in 426
publications by universities in 47, 48, 49, 51, 52, 53, 55, 387–8, 398, 399
regional distribution of universities in 377–8, 385, 389–90, 401
sources of funding in 65, 66, 68, 70, 71, 89, 91, 94, 104, 253, 380–81, 387, 396, 397, 301
teaching load in 50, 72
technical efficiency in joint production of education and research in 165
technical efficiency in research in 162–3, 173–4
tertiary education expenditure as a percentage of GDP 100, 101
trade-off between research intensity and teaching efficiency in 168, 170, 171
unified higher education system in 73

specialist universities
change to/from generalist 57–9, 73, 228, 296, 298
definition of 428
features of 56
reputation of 75
sources of funding for 70–71
in Spain 385, 388, 389–90
in Switzerland 225–8, 237
spin-off companies 116, 117, 118, 120, 121, 122, 136, 137, 175
data collected by Aquameth/CHINC 411, 412, 441, 442
legislation in Italy 244
Norwegian academic faculty members involved in 129–33
revenues in Italy 255
ST Microelectronics 253
staff
data collected by Aquameth/CHINC 408, 410–12, 417–19, 434, 435, 439–40
indicators used by
Aquameth/CHINC 423
see also academic staff; technical and administrative staff
Stanford University 116, 121
Stankiewicz, R. 176
Stephen, P.E. 79, 176, 260
Stokes, D.E. 119
strategic profile of universities 8–19
conceptual issues 8–14
methodological puzzles 14–19
strategy
definition of 18–19
and efficiency in universities 144–5
Strathclyde University 54, 160
student grants 64, 65
student loans 78, 92
student/teacher ratio 291–2, 294, 323, 395, 420
subject mix, differences in 55–9
and indicators produced from the Aquameth database 424, 428–9
substitution effects 12–13, 24
between R&D carried out at different periods of time 324
between teaching and research 165–72
between third-mission activities and basic research 175–9
sunk costs 13
support staff see technical and administrative staff
Surrey University 45
Sweden 136
Swiss Federal Statistical Office 215, 216, 274, 412
Swiss Innovation Agency 215, 222
Swiss National Science Foundation 222
Swiss Science Council 224
Swiss University Conference (SUC) 219, 224
Switzerland
age of universities in 35
Aquameth/CHINC data availability for 415, 417
Aquameth/CHINC data sources for 409, 412, 413
Aquameth database covering 408, 433
binary education system in 73, 211–12, 217, 425
changes in tertiary education expenditure over time 101
cost structure of Swiss universities 272–99
costs and cost structures 276–88
discussion 296–9
introduction 272–4
sample and available data 274–6, 303–4
short-run marginal cost, economies of utilization and short-run economies of scope 294–6
variable cost function for Swiss universities 288–94
disciplinary differences versus university strategies in 213–14
governance system in 210–13, 217–20, 223–5, 237, 274
growth rate of universities in 60, 62
internal organization of HEIs in 229–31
number of institutions in Aquameth/CHINC samples 442
numbers of PhD recipients and students in 39, 40–41, 42, 43, 44, 45, 46, 55, 72
offering profile of universities in 58, 231–2, 233, 234
patterns of diversity in higher education system in 209–38
comparing individual higher education institutions 225–36
fragmented governance and funding landscape 217–25
framework and research issues 210–14
sources and quantitative information 214–16
striving for room to manoeuvre 236–8
postgraduate education system in 172, 173
publications by universities in 47, 48, 49, 50, 51, 52, 53, 55, 72, 234, 236, 278, 279
R&D allocation by sector in 125
research contracts for PhD students in 418
research in Swiss HEIs 232–6
sources of funding in 63, 66, 67, 68, 70, 89, 90, 91, 95, 103, 104, 106, 124–9, 220–23, 224–5, 251, 253, 274
standard cost based funding system proposed for 273–4
technical efficiency in joint production of education and research in 165
technical efficiency in research in 162–3, 173–4
tertiary education expenditure as a percentage of GDP 101
third-mission activities of HEIs in 236
two major sources of diversity in HEIs in 237
Système d’Information Universitaire Suisse (SIUS) 215–16, 274, 276, 412

Taddei, F. 260
Tavernier, M. 166
tax credits and exemptions 64, 65, 126, 255
teacher exemption clauses 114, 133, 136, 138
teaching
efficiency trade-off between teaching and research? 165–72
Italian promotion system and shift towards 260–62
returns to scale in 151, 156–62
effects of scale on joint production of education and research 152, 165
teaching assistants 166, 291, 297, 439
teaching load 50, 167, 291–2, 294, 323, 395, 420
teaching staff ratio 291–2, 294, 323, 395, 420
technical and administrative staff
Aquameth/CHINC definition of 439
evolution in Portuguese public universities 357
expenditure on 282, 322
and research productivity 331–4, 335, 345
female 393, 394
headcount data lacking in UK 312
increase in proportion in UK universities 317, 321
number in Spanish universities 393, 395
as a percentage of total staff 281, 423
ratio of academic staff to 393, 394
in top 25 universities in terms of PhD recipients 42–5
working conditions in Spain 382
technical efficiency in universities 144–80
conclusions 179–80
conditional efficiency 148–50
data description and estimation strategy 150–53
descriptive statistics 194–206
evidence for economies of scale 153–65
economies of scale in education 156–62
effects of scale on joint production of education and research 165, 203–4
efficiency and economies of scale in research 162–4, 201–2
level of analysis 153–4
previous empirical evidence 154–5
methods used in analysis of 146–8
strategy and efficiency in universities 144–5
three requirements for analysing 145–6
trade-off between teaching and research? 165–72
trade-off between third-mission activities and basic research? 175–9
technical sciences
average number of students in Swiss universities 297
costs related to 278, 280, 281, 282, 284, 287, 369
doctoral degrees awarded in 360
evolution of number of undergraduate students in 288, 352–3
percentage of higher education students in 388, 391
publications in 364–5
specialization in 56, 58, 225–8, 237, 274, 275, 276, 315, 330, 332, 334, 335, 345, 369, 385, 388, 389–90
Technical University of Cartagena 58, 388, 390
Technical University of Catalonia 389
Technical University of Madrid 71, 390
Technical University of Valencia 71, 390
Technische Universität München 106, 254
technology transfer offices (TTOs) 117, 118, 120, 121, 122, 124, 136, 137, 236, 255, 412
Técnica de Lisboa 349, 368, 369, 370
Teesside University 61, 62, 69
Teichler, U. 4, 277, 349
Teixeira, P. 77, 86, 181, 347, 349, 350, 352, 356, 372
teledcommunications, patents in field of 136
temporary staff 417–18
tenureship 258, 260–61, 386, 400–401
Teramo University 60, 62
Thames Valley University 68
Theisens, H. 310, 337
Thelin, J.R. 8
theology, specialization in 225, 282
Theves, J. 409, 431
‘third mission’ of universities 112–39
administrative and managerial staff required for 317–20
conclusions 137–9
emergence of 113–16
entrepreneurial universities 116–19, 138–9, 175
included in Aquameth 2 project 180
Italian HEIs 244–5
measuring commercialization 119–23
measuring science-directed commercialization 129–37
measuring user-directed commercialization by funding from private sources 123–9, 137, 139
Swiss HEIs 236
trade-off between basic research and 175–9
Thoma, G. 176
time horizon 26
time lags 323–4
time use surveys 277
Tirole, J. 20, 263
Toft, A. 296
Tonio, G. 260
Top-up Fees legislation (2004) 308
Torino Politecnico 68, 70, 241, 251, 253
Torino University 52, 58, 251
total expenditures, Aquameth/CHINC
definition of 438
total revenues, Aquameth/CHINC
definition of 434–5, 436
trades unions 383
Trajtenberg, M. 176
Trannoy, A. 6
Tremblay, K. 16
Trento University 58, 68, 71, 249, 253
Trieste University 53, 68, 71, 251, 253
Trivellato, P. 242
Tromsø University 128, 137
Trow, M. 3–4, 5
Trowler, T. 213
TUB (university benchmarker) 456–7
tuition fees 88
data collected by Aquameth/CHINC 414–15, 417, 436, 437
differentiated 6, 70, 73, 74, 75, 76, 78, 104, 108, 308, 373
growth in UK 316, 318
inter-country comparisons 91–2, 93–5, 108
maximum fee in UK 307, 308
for overseas students in UK 337
Portuguese system 354–5, 356, 363, 373
postgraduate education 88, 355
as share of funding 64, 65, 66, 67, 68–9, 70, 73, 75, 85, 96, 103–4, 105, 108, 253, 317, 319, 355, 356, 381, 396, 397, 401
Twente University 254

UBI see Beira Interior University (UBI)
Udine University 69, 71, 251
Ugelstad, John 118
uncertainty, strategy under 11–12
unconditional efficiency score 150, 152, 162–3, 165, 191, 192
undergraduate students
data collected by Aquameth/CHINC 420–21, 440, 441
expenditure per head in Portuguese universities 361–3
expenditure per head in UK universities 322, 323
international mobility of 16
numbers enrolled and variable cost 291, 293
numbers in Swiss universities 277, 279, 283–4, 287, 288, 289
numbers in UK universities 321–3, 327, 328, 329, 330, 331
per professor in Swiss universities 277, 279, 282, 283–4, 285, 286–7, 297
rate of growth in total number of 32, 59–63, 73, 167, 287, 288, 321–3
ratio of graduates per undergraduate in Portuguese universities 362–3
unified systems 5, 73
unit of analysis, choice of 22–3, 145, 153–4, 406
United Kingdom
age of universities in 35, 314–16, 427
Aquameth/CHINC data availability for 415, 417
Aquameth/CHINC data sources for 409, 412, 413
Aquameth database covering 408, 433
Aquameth 2 covering 181
changes in tertiary education expenditure over time 101
economies of scale in teaching in 159–62
evolution of HE system in 315–16
government policy in 62
growth rate of universities in 60, 61, 62
knowledge production function for 306–36
conclusions 336
data sources 312–14
funding system and evaluation 309–11
institutional background 307–9
introduction 306–7
quantitative indicators 314–23
research productivity in UK higher education 323–36
results for total research outputs 345–6
variable definitions 340–43
number of institutions in Aquameth/CHINC samples 442
number of PhD recipients and students in 39, 40, 41, 42, 43, 44, 45, 46–7, 55, 72
postgraduate education system in 173
publications by universities in 47–8, 49, 50, 53–5, 72, 327, 328, 329, 330–36
R&D allocation by sector in 125
sources of funding in 64, 65–6, 68, 69, 70, 71, 89, 90, 92, 95, 103, 104, 105, 106, 108, 109, 124–8, 253, 308, 316–20, 332, 333, 335
tertiary education expenditure as a percentage of GDP 100, 101
trade-off between research intensity and teaching efficiency in 168–9, 172
unified higher education system in 73
units of assessment (UoAs) 310–11
number of, and research productivity 330, 332, 345
Universidad Nacional de Educación a Distancia 68
Universidad Politécnica de Cataluña 254
Universidade Aberta 349
Universidade da Beira Interior see Beira Interior University (UBI)
Universidade de Trás-os-Montes e Alto Douro 174
Universidade do Algarve see Algarve University
Università della Svizzera italiana (USI)
basic academic staff per professor in 279, 283, 284
average costs per undergraduate student in 279, 280, 283, 284
average labour price in 279, 283, 284
curriculum 223
descriptive statistics and indicators 279
domains of specialization 225, 227, 280
floor space in 279, 283, 284
growth rate of 60
internal organization of 230
PhD degrees per undergraduate students 279, 283, 284
publications by 279
sources of funding 66, 68, 70
students per professor in 279, 283, 284
undergraduate students in 279, 283, 284
Universitet for miljø og biowitenskap 106
Universities of Applied Science (UAS) 425
domains of specialization 226–7, 228
duration of undergraduate degree courses in 420
entry requirements for students 231
funding of 222
governance of 217, 218, 220, 224, 229
internal organization of 230, 231
research by 235
subjects offered by 232, 233
third-mission activities by 236
University Act (Switzerland, 1969, revised 1999) 218, 219, 222
university benchmarker (TUB) 456–7
University College London attempted merger with Imperial College 155
descriptive statistics and indicators 42, 45, 54
PhD recipients 41, 42, 45
PhD students in 38, 39
publications by 47, 54
ratio of PhD recipients to undergraduate degrees 45
sources of funding 68, 71, 127
total staff employed 160
university degrees
data collected by Aquameth/CHINC 420–21, 440, 441
efficiency trade-off between teaching and research? 165–72
number of first degrees awarded in Portuguese universities 358, 359
number of first degrees awarded in UK universities 328, 329
quality assessment in Portugal 350
ratio of graduates per undergraduate in Portuguese universities 362–3
ratio of total expenses per graduate in Portuguese universities 363, 367–8
returns to scale in production of 151, 156–62
effects of scale on joint production of education and research 152, 165
university-dominated systems 5, 73, 263
University of Manchester Institute of Science and Technology (UMIST) 45, 71
university profiles 148
user-directed commercialization 117, 120
as distinct from science-directed commercialization 117–18
indicators of 121–2, 137
measuring by funding from private sources 123–9, 137, 139
UTAD see Irás os Montes e Alte Douro (UTAD)

Valencia Politechnic see Technical University of Valencia
Valencia University
age of 35, 376, 390
changes in offering profile of 58 descriptive statistics and indicators 43, 52, 390
governance of 376
PhD recipients 43
publications by 47, 48, 52
Valladolid University 35, 376, 390
Vallas, S.P. 115
Valle d’Aosta University 59, 60
Van Looy, B. 115, 118, 123, 133, 138, 176

van Pottelsberghe, B. 324
Van Raan, A. 421
van Vught, F.A. 10, 211, 425
variable cost function for Swiss universities 288–94
Vavakova, B. 115
Venezia University 69, 251
venture capital industry 51
Vermersch, D. 300
Verona University 75, 251
Verry, D.W. 154
vertical differentiation 5–6, 7, 14, 18, 51
vice-chancellors 377, 386
Vidal, J. 377, 381
Vigo University 390
Villarreal, E. 380
Visco, V. 260
vocational training 4, 5, 6, 73, 263, 307
Vock, P. 236
von Tunzelmann, N. 154
Vossensteyn, J.J. 86, 90, 91
Vysoká škola chemicko-technologická v Praze 106
Walckiers, A. 21, 167
Warwick University 54, 159
Wauthy, X. 21, 166
Web of Science 387
Weber, K. 211, 214, 228
Weick, K.E. 10
Wiener, N. 26
Wilkin, L. 166
Williams, G. 155
Willig, R.D. 296
Wilson, P.W. 148, 190
Winnes, M. 167
Winston, G.C. 261
Wittrock, B. 34
Wooldridge, J.M. 327
Worthington, A.C. 147
Wyatt, G. 154
York University 54, 61, 62

Zaragoza University 35, 68, 71, 389
Zedonis, A.A. 114
Zucker, L.B. 9, 114, 117
Zürcher Fachhochschule 227
Zurich University
academic staff per professor in 279, 283, 284
average costs per undergraduate student in 279, 280, 283, 284, 297
average labour price in 279, 283, 284
changes in offering profile of 58, 233
descriptive statistics and indicators 42, 44, 52, 275, 279
domains of specialization 225, 226, 274, 275, 280
economies of scale in teaching in 157

evolution of expenditures and number of students in 289
floor space in 279, 283, 284
internal organization of 230
PhD degrees per 100 undergraduate students 279, 283, 284
PhD recipients 41, 42, 44
PhD students in 39
publications by 52, 236, 279
ratio of PhD recipients to undergraduate degrees 44
sources of funding 128
students per professor in 279, 282, 283, 284
undergraduate students in 275, 279, 283, 284, 289