

```

1
2 Sets
3     sec sectors /sec1, sec2, sec3 /
4     en(sec) energy input /sec3/
5     nen(sec) non-energy inputs /sec1, sec2/
6 ;
7
8 Alias
9     (sec,secc)
10 ;
11
12
13 Scalars
14     PKZ initial return to capital      / 1 /
15     PLZ initial wage rate             / 1 /
16
17     KSZ initial capital endowment
18     LSZ initial labor endowment
19
20     YZ  initial income level
21     UZ  initial utility level for the household
22 ;
23
24
25 Parameters
26
27     PDZ(sec)      initial commodity price level      /sec1 1, sec2 1, sec»
3 1 /
28     PKLEZ(sec)    initial price level of capital-labor-energy bundle
29                  /sec1 1, sec2 1, sec3 1 /
30
31     PKEZ(sec)     initial price level of capital-energy bundle
32                  /sec1 1, sec2 1, sec3 1 /
33
34     XDZ(sec)      initial gross production (output) level
35
36     KZ(sec)       initial capital demand
37     LZ(sec)       initial labor demand
38     CZ(sec)       initial consumer commodity demand
39
40     IOZ(nen,sec)  initial intermediate commodity demand
41     EZ(sec)       initial demand of energy input
42     KLEZ(sec)     initial demand of Capital-Labor-Energy bundle
43     KEZ(sec)      initial demand of Capital-Energy bundle
44
45
46     io(sec,secc)  technical coefficients
47     aF1(sec)      efficiency parameter of the production function of fi»
48     rm(sec) (first nest)
49     aF2(sec)      efficiency parameter of the production function of fi»
50     rm(sec) (second nest)
51     aF3(sec)      efficiency parameter of the production function of fi»
52     rm(sec) (third nest)
53     alphaKLE(sec) Cobb-Douglas power of KLE in the production function »
of firm(sec)
54     alphaL(sec)   Cobb-Douglas power of L in the production function of»
55     firm(sec)
56     alphaKE(sec)  Cobb-Douglas power of KE in the production function o»
57     f firm(sec)
58     alphaK(sec)   Cobb-Douglas power of K in the production function of»
59     firm(sec)

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54      alphaE(sec)      Cobb-Douglas power of E in the production function of»
      firm(sec)
55      alphaH(sec)      Cobb-Douglas power of commodity(sec)in household util»
      ity function
56 ;
57
58
59 Table
60      IOZ(nen,sec)
61          sec1      sec2      sec3
62      sec1      5      40      15
63      sec2      15      20      10
64 ;
65
66
67
68 Table
69      dataz(*,sec)
70          sec1      sec2      sec3
71      KZ      60      50      40
72      LZ      20      90      30
73      CZ      50      180      60
74      EZ      10      25      5
75 ;
76
77
78      KZ(sec) = dataz("KZ",sec) ;
79      LZ(sec) = dataz("LZ",sec) ;
80      CZ(sec) = dataz("CZ",sec) ;
81      EZ(sec) = dataz("EZ",sec) ;
82
83
84      KSZ = sum(sec, KZ(sec)) ;
85      LSZ = sum(sec, LZ(sec)) ;
86
87
88      KLEZ(sec) = EZ(sec) + KZ(sec) + LZ(sec);
89
90
91      KEZ(sec) = EZ(sec) + KZ (sec);
92
93      XDZ(sec) = sum(nen, ioz(nen,sec)) + EZ(sec) + KZ(sec) + LZ(sec) ;
94
95
96      YZ = PKZ*KSZ + PLZ*LSZ ;
97 display
98      KLEZ
99      KEZ
100     XDZ
101     YZ
102     CZ
103 ;
104
105
106     io(nen,secc) = IOZ(nen,secc) / XDZ(secc) ;
107
108
109     alphaH(sec) = PDZ(sec)*CZ(sec) / YZ ;
110
111
112     UZ = prod(sec, CZ(sec)**alphaH(sec)) ;

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113
114
115     aF1(sec) = XDZ(sec)/KLEZ(sec) ;
116
117
118     alphaKE(sec) = PKEZ(sec)*KEZ(sec) / ( PKEZ(sec)*KEZ(sec) + PLZ*LZ(se»
c) ) ;
119     alphaL(sec) = 1 - alphaKE(sec);
120     aF2(sec) = KLEZ(sec) / ( KEZ(sec)**alphaKE(sec) *LZ(sec)**alphaL(sec»
) ) ;
121
122
123     alphaK(sec) = PKZ*KZ(sec) / ( PKZ*KZ(sec) + PDZ("sec3")*EZ(sec) ) ;
124     alphaE(sec) = 1 - alphaK(sec);
125     aF3(sec) = KEZ(sec) / ( KZ(sec)**alphaK(sec) *EZ(sec)**alphaE(sec) )»
;
126
127 display
128     alphaH
129     alphaK
130     alphaE
131     alphaL
132     alphaKE
133     aF1
134     aF2
135     aF3
136     io
137 ;
138
139
140 Variables
141
142     PK           return to capital
143     PL           wage rate
144     PD(sec)     commodity prices
145     PKLE(sec)   capital-labor energy bunlde prices
146     PKE(sec)    capital-energy bundle prices
147
148
149     KS           capital endowment (exogenous)
150     LS           labor endowment (exogenous)
151     XD(sec)     gross output
152
153     K(sec)      capital demand by firms
154     L(sec)      labor demand by firms
155     C(sec)      consumer commodity demand
156
157     E(sec)      demand of energy inputs by firm (sec)
158     KLE(sec)    demand of capital-labor-energy bundle by firm (sec)
159     KE(sec)     demand of capital-energy bundle by firm (sec)
160
161     Y           household's income
162
163     TRICK       artificial objective variable
164 ;
165
166 Positive variables
167
168     PK, PL, PD, PKLE, PKE, KS, LS, XD, K, L, E, KLE, KE, C, Y ;
169
170

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171
172 Equations
173
174 * HOUSEHOLDS
175
176          EQC(sec)          consumer demand function for commodity(sec»
)
177
178 * FIRMS
179
180          EQKLE(sec)        demand of capital-labor-energy bundle
181          EQPROFIT(sec)     zero profit condition for the firms (first nest)
182          EQKE(sec)         capital-energy bundle demand function firm(sec)
183          EQL(sec)          labor demand function firm(sec)
184          EQPROFITKLE(sec)  zero profit condition for the firms (second nest)
185          EQK(sec)          capital demand function firm(sec)
186          EQE(sec)          energy demand function firm(sec)
187          EQPROFITKE(sec)   zero profit condition for the firms (third nest)
188
189 * MARKET CLEARING
190
191          EQMARKETL         market clearing for labor
192          EQMARKETK         market clearing for capital
193          EQMARKETC(sec)    market clearing for commodities
194
195 * DEFINITIONS
196
197          EQINCOME          income
198
199 *CO2 KIBOCSÁTÁS EGYENLETEI
200
201 * OBJECTIVE FUNCTION
202
203          OBJECTIVE         objective function
204
205 ;
206
207
208          EQC(sec)..        PD(sec)*C(sec) =E= alphaH(sec)*Y ;
209
210
211          EQKLE(sec)..      KLE(sec)      =E=  XD(sec)/aF1(sec) ;
212
213          EQKE(sec)..      KE(sec)        =E=  (KLE(sec)/aF2(sec))*
214          (alphaKE(sec)*PL/(alphaL(sec)*PKE(sec))»
) **alphaL(sec) ;
215
216          EQL(sec)..      L(sec)          =E=  (KLE(sec)/aF2(sec))*
217          (alphaL(sec)*PKE(sec)/(alphaKE(sec)*PL)»
) **alphaKE(sec) ;
218
219          EQK(sec)..      K(sec)          =E=  ( KE(sec)/aF3(sec) ) *
220          ( alphaK(sec)*PD("sec3")/( alphaE(sec)»
*PK) ) **alphaE(sec) ;
221
222          EQE(sec)..      E(sec)          =E=  ( KE(sec)/aF3(sec) ) *
223          ( alphaE(sec)*PK/(alphaK(sec)*PD("sec3»
")) ) **alphaK(sec) ;
224
225
226          EQPROFIT(sec)..  PD(sec)*XD(sec) =E= PKLE(sec)*KLE(sec)+

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227             sum(nen,io(nen,sec)*XD(sec)*PD(nen)) ;
228
229
230
231 EQPROFITKLE(sec).. PKLE(sec)*KLE(sec) =E= PKE(sec)*KE(sec)+ PL*L(sec) ;
232
233
234 EQPROFITKE(sec).. PKE(sec)*KE(sec) =E= PK*K(sec) + PD("sec3")*E(sec) ;
235
236
237
238 EQMARKETL..             sum(sec, L(sec)) =E= LS ;
239 EQMARKETK..             sum(sec, K(sec)) =E= KS ;
240 EQMARKETC(sec)..       C(sec)+sum(secc,E(secc))$sameas(sec,"sec3")
241 +sum(secc, io("sec1",secc)*XD(secc))$sameas(sec,"sec1")
242 +sum(secc, io("sec2",secc)*XD(secc))$sameas(sec,"sec2")
243 =E= XD(sec) ;
244
245
246
247 EQINCOME..             Y =E= PK*KS + PL*LS ;
248
249
250 OBJECTIVE..           TRICK =E= 1 ;
251
252
253
254 Model ECGE
255     /EQC,
256     EQKLE
257     EQPROFIT
258     EQKE
259     EQL
260     EQPROFITKLE
261     EQK
262     EQE
263     EQPROFITKE
264     EQMARKETK,
265 *    EQMARKETL,
266     EQMARKETC,
267     EQINCOME,
268
269     OBJECTIVE /;
270
271
272     PK.L           = PKZ           ;
273     PL.L           = PLZ           ;
274     PD.L(sec)     = PDZ(sec) ;
275     PKLE.L(sec)   = PKLEZ(sec) ;
276     PKE.L(sec)    = PKEZ(sec) ;
277     XD.L(sec)     = XDZ(sec) ;
278     K.L(sec)      = KZ(sec) ;
279     L.L(sec)      = LZ(sec) ;
280     E.L(sec)      = EZ(sec) ;
281     C.L(sec)      = CZ(sec) ;
282     Y.L           = YZ           ;
283     Trick.L       = 1           ;
284
285
286     PK.LO          = 0.001*PKZ     ;
287     PL.LO          = 0.001*PLZ     ;

```

```
288         PKLE.LO(sec)= 0.001*PKLEZ(sec)   ;
289         PKE.LO(sec) = 0.001*PKEZ(sec)    ;
290         PD.LO(sec) = 0.001*PDZ(sec);
291         XD.LO(sec) = 0.001*XDZ(sec);
292         K.LO(sec)  = 0.001*KZ(sec)  ;
293         L.LO(sec)  = 0.001*LZ(sec)  ;
294         KLE.LO(sec)= 0.001*KLEZ(sec);
295         KE.LO(sec)= 0.001*KEZ(sec);
296         C.LO(sec)  = 0.001*CZ(sec)  ;
297         Y.LO      = 0.001*YZ      ;
298
299
300
301         KS.FX = KSZ;
302         LS.FX = LSZ;
303
304 * Fixing the numeraire
305
306         PL.FX = PLZ;
307
308 Solve   ECGE using NLP maximizing TRICK ;
309
310 display
311         KS.L
312         LS.L
313         PK.L
314         PL.L
315         PD.L
316         K.L
317         L.L
318         XD.L
319         C.L
320         Y.L
321 ;
322
323
```