

\$TITLE: M4-3b.GMS: modeling health insurance

* with moral hazzard, adverse selection modeled as an MCP

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MODELING DEMAND FOR HEALTH INSURANCE

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                                     |---Sick
      |---Do not buy Insurance--choose effort --|
      |                                           |---Healthy
Income---|
+ Type   |                                           |---Sick
      |--- Buy Insurance      --choose effort---|
                                               |---Healthy

```

\$OFFTEXT

PARAMETERS

M0 income in the first time period

MH income in the second time period when healthy

MS income in the second time period when sick (before insurance)

ACUF acutuarily fairness 1 = actuarily fair ACUF < 1 unfair

BETA needed to make the consumption concave(diminishing returns)

TYPE1 low-risk type

TYPE2 high-risk type

RISKAV average riskiness at effort = 0

EFFT1 effort of type 1

EFFT2 effort of type 2

PROFIT1 profit from insuring type 1

PROFIT2 profit from insuring type 2

PROFIT profit for insurance company from insuring person 1 and 2;

ACUF=1.0;

BETA = 0.5;

M0 = 10;

MH = 10;

MS = 4;

TYPE1 = 0.5; TYPE2 = 0.5;

RISKAV = ((1-TYPE1)+(1-TYPE2))/2;

*PROFIT = 0;

POSITIVE VARIABLES

U1 expected utility type 1

INS1 insurance purchased

PNS1 payoff from insurance if sick

ALPHA1 probability of good health

EFFORT1 effort spent to insure good health: diet exercise and such

LAMINS1 Lagrangean multiplier on constraint equation INSURANCE1

LAMEFF1 Lagrangean multiplier on constraint equation MORALHAZ1

U2 expected utility type 2
 INS2 insurance purchased
 PNS2 compensation from purchasing insurance if sick
 ALPHA2 probability of good health
 EFFORT2 effort spent to insure good health: diet exercise and such
 LAMINS2 Lagrangean multiplier on constraint equation INSURANCE2
 LAMEFF2 Lagrangean multiplier on constraint equation MORALHAZ2;

EQUATIONS

UTILITY1 expected utility type 1
 INSURANCE1 the amount of insurance purchased
 MORALHAZ1 good health depends on effort but effort reduces U
 FOCINS1 first-order condition for insurance purchased
 FOC PNS1 first-order condition for payoff when sick
 FOCEFF1 first-order condition for effort1
 FOCALP1 first-order condition for alpha1

 UTILITY2 expected utility type 2
 INSURANCE2 the amount of insurance purchased
 MORALHAZ2 good health depends on effort but effort reduces U
 FOCINS2 first-order condition for insurance purchased
 FOC PNS2 first-order condition for payoff when sick
 FOCEFF2 first-order condition for effort2
 FOCALP2 first-order condition for alpha2;

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UTILITY1..      U1 =E= (M0-INS1)**BETA
                  + ALPHA1*MH**BETA + (1-ALPHA1)*(MS+PNS1)**BETA
                  - 0.1*(0.3 + EFFORT1)**2;

INSURANCE1..    INS1*ACUF =E= PNS1*RISKAV;

MORALHAZ1..    TYPE1 + 0.15*EFFORT1 =G= ALPHA1;

FOCINS1..      BETA*(M0-INS1)**(BETA-1) =G= LAMINS1*ACUF;

FOCPNS1..      LAMINS1*RISKAV =G= (1-ALPHA1)*BETA*(MS+PNS1)**(BETA-1);

FOCEFF1..      0.2*(0.3+EFFORT1) =G= 0.15*LAMEFF1;

FOCALP1..      LAMEFF1 =G= MH**BETA - (MS+PNS1)**BETA;

UTILITY2..      U2 =E= (M0-INS2)**BETA
                  + ALPHA2*MH**BETA + (1-ALPHA2)*(MS+PNS2)**BETA
                  - 0.1*(0.3 + EFFORT2)**2;

INSURANCE2..    INS2*ACUF =E= PNS2*RISKAV;

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MORALHAZ2..    TYPE2 + 0.15*EFFORT2 =G= ALPHA2;

FOCINS2..     BETA*(M0-INS2)**(BETA-1) =G= LAMINS2*ACUF;

FOCPNS2..     LAMINS2*RISKAV =G= (1-ALPHA2)*BETA*(MS+PNS2)**(BETA-1);

FOCEFF2..     0.2*(0.3+EFFORT2) =G= 0.15*LAMEFF2;

FOCALP2..     LAMEFF2 =G= MH**BETA - (MS+PNS2)**BETA;

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MODEL INSURE /UTILITY1.U1, INSURANCE1.LAMINS1, MORALHAZ1.LAMEFF1
          FOCINS1.INS1, FOCPNS1.PNS1, FOCEFF1.EFFORT1, FOCALP1.ALPHA1
          UTILITY2.U2, INSURANCE2.LAMINS2, MORALHAZ2.LAMEFF2
          FOCINS2.INS2, FOCPNS2.PNS2, FOCEFF2.EFFORT2, FOCALP2.ALPHA2/;

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U1.L = 1;
INS1.L = 2;
PNS1.L = 4;
ALPHA1.L = 0.5;
EFFORT1.L = 0;
U2.L = 1;
INS2.L = 2;
PNS2.L = 4;
ALPHA2.L = 0.5;
EFFORT2.L = 0;

```

SOLVE INSURE USING MCP;

PROFIT1 = INS1.L - (1 - ALPHA1.L)*PNS1.L;

PROFIT2 = INS2.L - (1 - ALPHA2.L)*PNS2.L;

PROFIT = PROFIT1 + PROFIT2;

EFFT1 = EFFORT1.L;

EFFT2 = EFFORT2.L;

DISPLAY TYPE1, TYPE2, EFFT1, EFFT2, PROFIT1, PROFIT2, PROFIT;

** counterfactual: two risk types*

TYPE1 = 0.55;

TYPE2 = 0.45;

RISKAV = ((1-TYPE1)+(1-TYPE2))/2;

SOLVE INSURE USING MCP;

PROFIT1 = INS1.L - (1 - ALPHA1.L)*PNS1.L;

PROFIT2 = INS2.L - (1 - ALPHA2.L)*PNS2.L;

PROFIT = PROFIT1 + PROFIT2;

EFFT1 = EFFORT1.L;

EFFT2 = EFFORT2.L;

DISPLAY TYPE1, TYPE2, EFFT1, EFFT2, PROFIT1, PROFIT2, PROFIT;

** can the insurance companies make money by offering actuarially
* unfair insurance?*

ACUF = 0.9;

SOLVE INSURE USING MCP;

PROFIT1 = INS1.L - (1 - ALPHA1.L)*PNS1.L;

PROFIT2 = INS2.L - (1 - ALPHA2.L)*PNS2.L;

PROFIT = PROFIT1 + PROFIT2;

EFFT1 = EFFORT1.L;

EFFT2 = EFFORT2.L;

DISPLAY TYPE1, TYPE2, EFFT1, EFFT2, PROFIT1, PROFIT2, PROFIT;