Value and Consumption Low vs Higher Discount Factor Comparison

This is the example vignette for function: **snw_vfi_main_bisec_vec** from the **PrjOptiSNW Package.**

This function solves for the V(states) for individuals at lower and higher discount factor β. We allow for β heterogeneity in the model to consider both patient and impatient households. The key difference is that patient households are more willing to save and will consume less.

Solve Model at $\beta = 0.95$

Our high type households have $\beta = 0.95$.

```
% mp_params = snw_mp_param('default_dense');
mp_params = snw_mp_param('default_docdense');
fl_higher_beta = 0.95;
fl_lower_beta = 0.60;
mp_params('beta') = fl_higher_beta;
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_timer') = true;
[V_ss_beta95,~,cons_ss_beta95,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=490.4065
```

Solve Model at $\beta = 0.60$

Our high type households have $\beta = 0.60$.

```
mp_params('beta') = fl_lower_beta;
mp_controls = snw_mp_control('default_test');
mp_controls('bl_print_vfi') = false;
mp_controls('bl_print_vfi_verbose') = false;
mp_controls('bl_timer') = true;
[V_ss_beta60,~,cons_ss_beta60,~] = snw_vfi_main_bisec_vec(mp_params, mp_controls);
```

```
Completed SNW_VFI_MAIN_BISEC_VEC;SNW_MP_PARAM=default_docdense;SNW_MP_CONTROL=default_test;time=487.891
```

Generate β Comparison Matrixes

Take the difference between $\beta = 0.95$ percent and $\beta = 0.60$ consumption and value n-dimensional matrixes. Welfare is converted to units in fixed life-time consumption. Note that for example: $\log(0.5) + 0 \cdot \log(0.5) > \log(0.5) + 0.99 \cdot \log(0.5)$, in another word, V is higher with lower β if utility per-period is a negative value. Note our $\gamma = 2$ for the CRRA parameter. We can compare V relatively across choices for the same individual, but less meaningfully across individuals with varying preferences.

```
gamma = mp_params('gamma');
mn_V_gain_beta = snw_hh_welfare(V_ss_beta95, gamma) - snw_hh_welfare(V_ss_beta60, gamma);
mn_C_gain_beta = cons_ss_beta95 - cons_ss_beta60;
```

```
fl_beta_gap = fl_higher_beta - fl_lower_beta;
```

Dense Param Results Define Frames

Define the matrix dimensions names and dimension vector values. Policy and Value Functions share the same ND dimensional structure.

```
% Grids:
age_grid = 18:100;
agrid = mp_params('agrid')';
eta_H_grid = mp_params('eta_H_grid')';
eta_S_grid = mp_params('eta_S_grid')';
ar_st_eta_HS_grid = string(cellstr([num2str(eta_H_grid', 'hz=%3.2f;'), num2str(eta_S_grid', 'wz
edu_grid = [0,1];
marry_grid = [0,1];
kids_grid = (1:1:mp_params('n_kidsgrid'))';
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
cl_mp_datasetdesc = {};
cl_mp_datasetdesc{1} = containers.Map({'name', 'labval'}, {'age', age_grid});
cl_mp_datasetdesc{2} = containers.Map({'name', 'labval'}, {'savings', agrid});
cl_mp_datasetdesc{3} = containers.Map({'name', 'labval'}, {'eta', 1:length(eta_H_grid)});
cl_mp_datasetdesc{4} = containers.Map({'name', 'labval'}, {'edu', edu_grid});
cl_mp_datasetdesc{5} = containers.Map({'name', 'labval'}, {'marry', marry_grid});
cl_mp_datasetdesc{6} = containers.Map({'name', 'labval'}, {'kids', kids_grid});
```

Analyze Difference in V and C with Higher and Lower β

The difference between V and C with higher and lower β.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
mp_support_graph('cl_st_xtitle') = {'Savings States, a'};
mp_support_graph('st_legend_loc') = 'eastoutside';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('it_legend_select') = 21; % how many shock legends to show
mp_support_graph('cl_colors') = 'jet';
```

MEAN(MN_V_GAIN(A,Z))

Tabulate value and policies along savings and shocks:

```
% Set
ar_permute = [1,4,5,6,3,2];
% Value Function
st_title = ['MEAN(MN_V_Gain(A,Z)), beta_gap=' num2str(fl_beta_gap) ];
tb_az_v = ff_summ_nd_array(st_title, mn_V_gain_beta, true, ["mean"], 4, 1, cl_mp_datasetdesc, a
```

```
xxx   MEAN(MN_V_Gain(A,Z)), beta_gap=0.35   xxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    group      savings      mean_eta_1    mean_eta_2    mean_eta_3    mean_eta_4    mean_eta_5    mean_eta_6    mean_
    _____    __________    __________    __________    __________    __________    __________    __________    _____

      1               0    -0.024097     -0.024617     -0.025187     -0.025805     -0.026469     -0.027179     -0.02
      2      0.00051498    -0.024183     -0.024702     -0.025271     -0.025888     -0.026552     -0.027262     -0.02
      3       0.0041199    -0.024775     -0.025289     -0.025853     -0.026468     -0.027129     -0.027835     -0.02
```

4	0.013905	-0.026309	-0.026811	-0.027367	-0.027974	-0.02863	-0.029331	-0.03
5	0.032959	-0.029045	-0.02953	-0.030076	-0.030675	-0.031325	-0.032021	-0.03
6	0.064373	-0.033059	-0.033528	-0.034063	-0.034657	-0.035302	-0.035994	-0.03

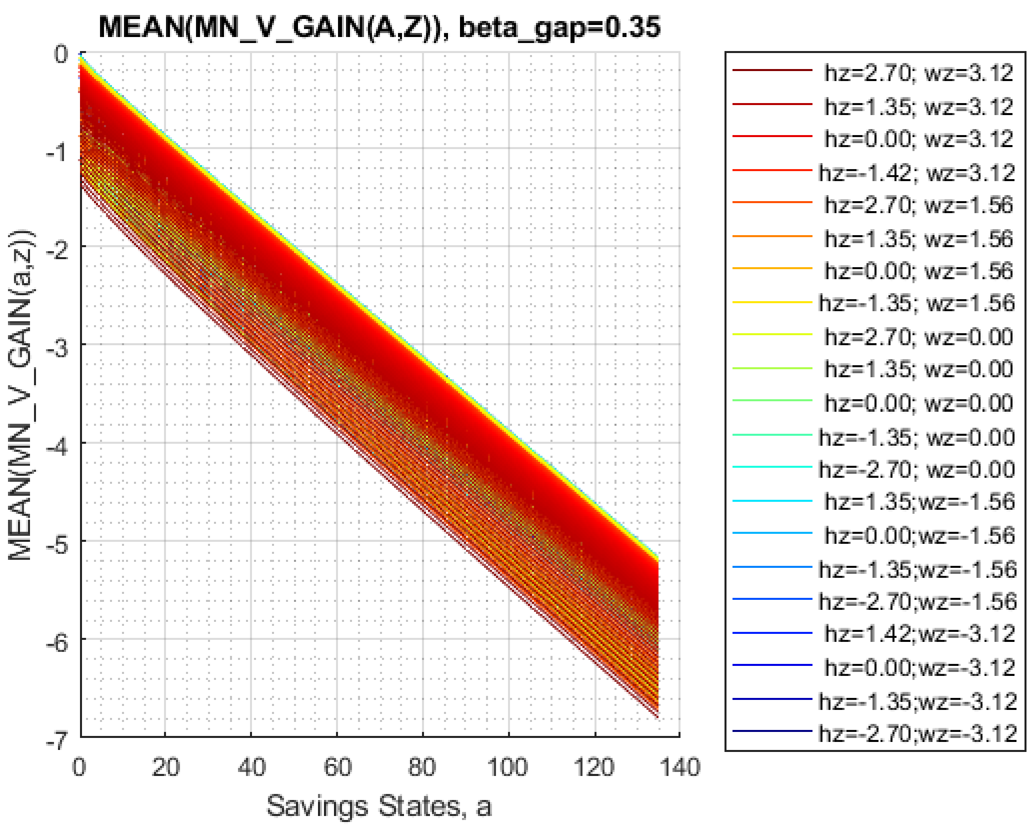
```
% Consumption
st_title = ['MEAN(MN_C_Gain(A,Z)), beta_gap=' num2str(fl_beta_gap) ];
tb_az_c = ff_summ_nd_array(st_title, mn_C_gain_beta, true, ["mean"], 4, 1, cl_mp_datasetdesc, a
```

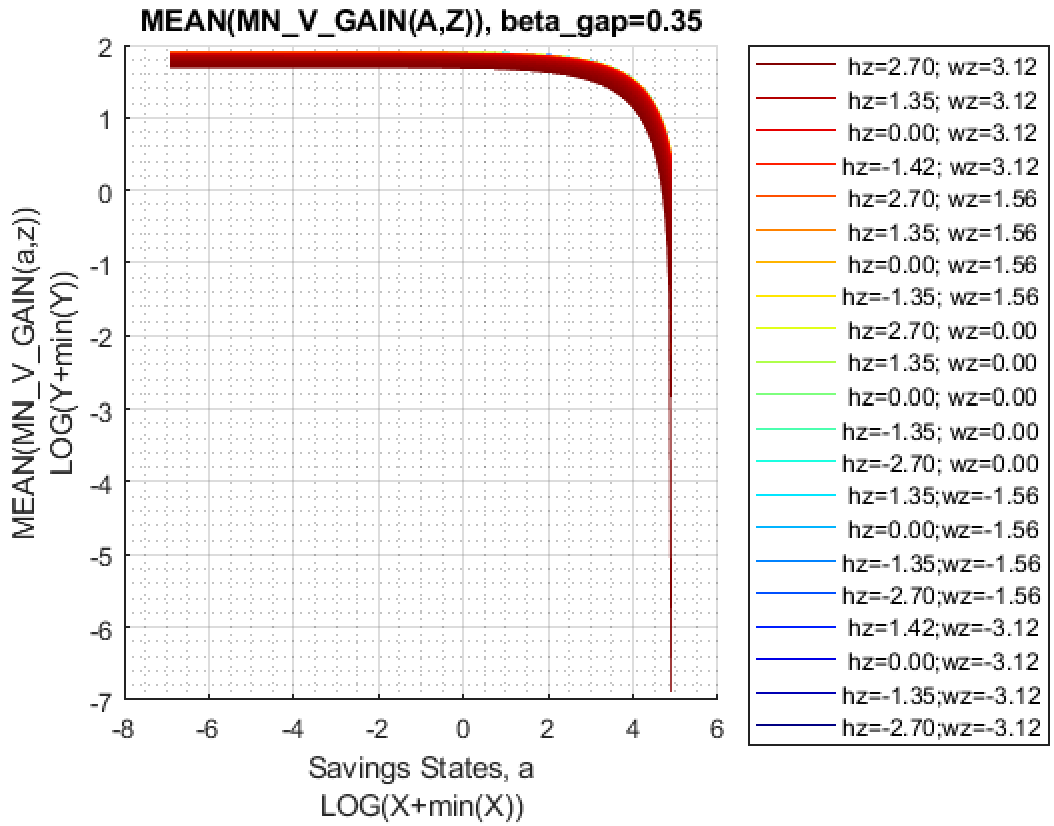
xxx MEAN(MN_C_Gain(A,Z)), beta_gap=0.35 xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	savings	mean_eta_1	mean_eta_2	mean_eta_3	mean_eta_4	mean_eta_5	mean_eta_6
1	0	0	0	0	0	0	0
2	0.00051498	0	0	0	0	0	0
3	0.0041199	-9.1299e-06	-2.1364e-05	-3.2174e-05	-3.8044e-05	-3.8335e-05	-3.6937e-05
4	0.013905	-0.0011906	-0.0012628	-0.0012873	-0.0012998	-0.0013031	-0.0012996
5	0.032959	-0.0042365	-0.0043329	-0.0044591	-0.004566	-0.0046594	-0.0047236
6	0.064373	-0.0099064	-0.010177	-0.010412	-0.010579	-0.010676	-0.010709

Graph Mean Values:

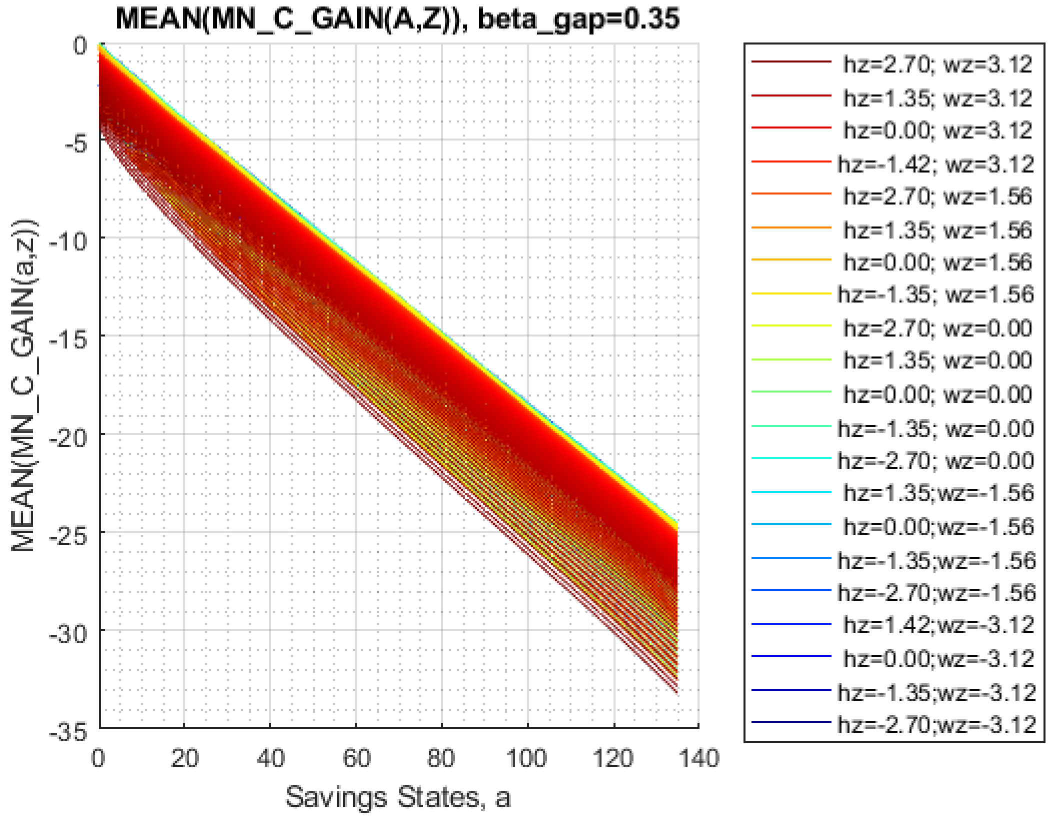
```
st_title = ['MEAN(MN\_V\_GAIN(A,Z)), beta\_gap=' num2str(fl_beta_gap)  ''];
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_GAIN(a,z))'};
ff_graph_grid((tb_az_v{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```

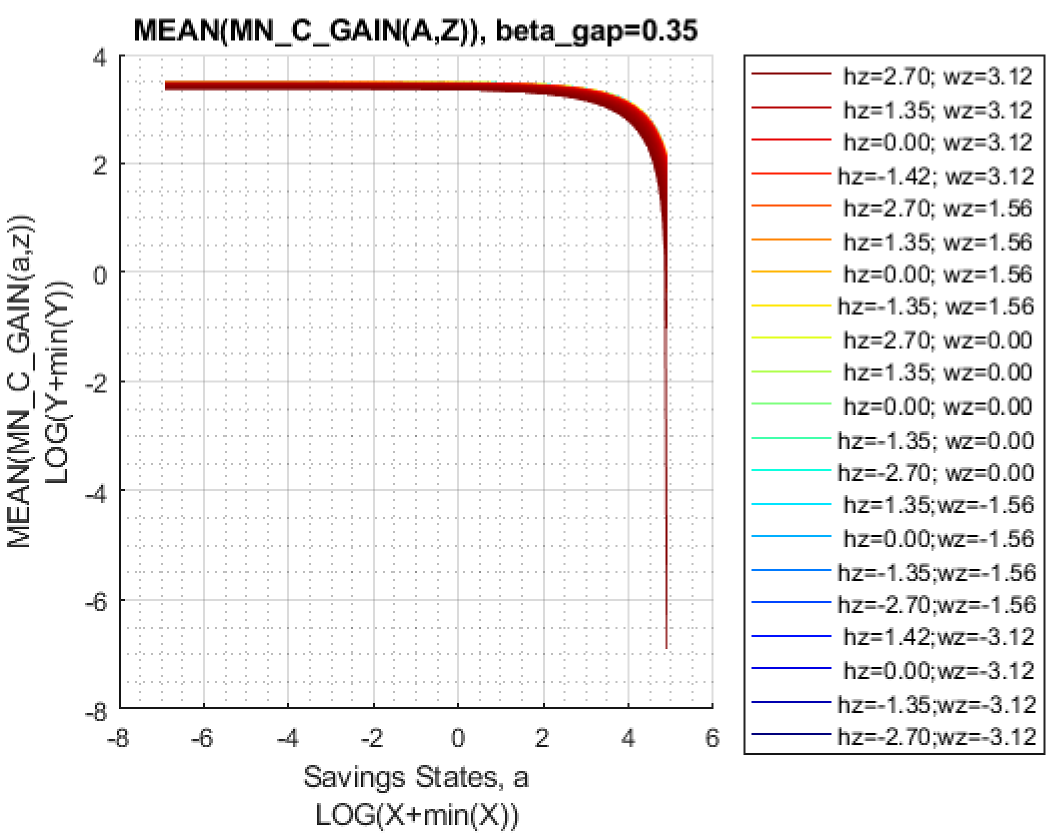




Graph Mean Consumption:

```
st_title = ['MEAN(MN\_C\_GAIN(A,Z)), beta\_gap=' num2str(fl_beta_gap)  ''];
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_C\_GAIN(a,z))'};
ff_graph_grid((tb_az_c{1:end, 3:end})', ar_st_eta_HS_grid, agrid, mp_support_graph);
```





Analyze Kids and Marriage and Age

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = [...
    "k0M0", "K1M0", "K2M0", "K3M0", "K4M0", ...
    "k0M1", "K1M1", "K2M1", "K3M1", "K4M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {...
    'o', 'd' ,'s', 'x', '*', ...
    'o', 'd', 's', 'x', '*'};
mp_support_graph('cl_colors') = {...
    'red', 'red', 'red', 'red', 'red'...
    'blue', 'blue', 'blue', 'blue', 'blue'};
```

MEAN(VAL(KM,J)), MEAN(AP(KM,J)), MEAN(C(KM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,4,1,6,5];
% Value Function
st_title = ['MEAN(MN_V_Gain(KM,J)), beta_gap=' num2str(fl_beta_gap) ];
tb_az_v = ff_summ_nd_array(st_title, mn_V_gain_beta, true, ["mean"], 3, 1, cl_mp_datasetdesc, a
```

xxx MEAN(MN_V_Gain(KM,J)), beta_gap=0.35 xxxxxxxxxxxxxxxxxxxxxxxxxxx

group	kids	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_22	mean_age_23
1	1	0	-2.3297	-2.3646	-2.4033	-2.4467	-2.4886	-2.529
2	2	0	-1.6829	-1.7078	-1.7361	-1.7685	-1.8005	-1.8322
3	3	0	-1.4479	-1.4653	-1.4856	-1.5093	-1.5326	-1.5554
4	4	0	-1.2769	-1.2904	-1.3063	-1.3254	-1.3441	-1.3624
5	5	0	-1.1689	-1.1787	-1.1908	-1.2057	-1.2203	-1.2345
6	1	1	-1.8594	-1.8945	-1.9328	-1.9753	-2.0168	-2.0573
7	2	1	-1.4942	-1.5203	-1.5493	-1.5821	-1.6145	-1.6464
8	3	1	-1.3397	-1.3604	-1.3836	-1.4101	-1.4362	-1.4617
9	4	1	-1.2093	-1.2257	-1.2444	-1.2661	-1.2875	-1.3085
10	5	1	-1.1227	-1.1351	-1.1495	-1.1667	-1.1835	-1.1998

```
% Consumption Function
st_title = ['MEAN(MN_C_Gain(KM,J)), beta_gap=' num2str(fl_beta_gap) ];
tb_az_c = ff_summ_nd_array(st_title, mn_C_gain_beta, true, ["mean"], 3, 1, cl_mp_datasetdesc, a
```

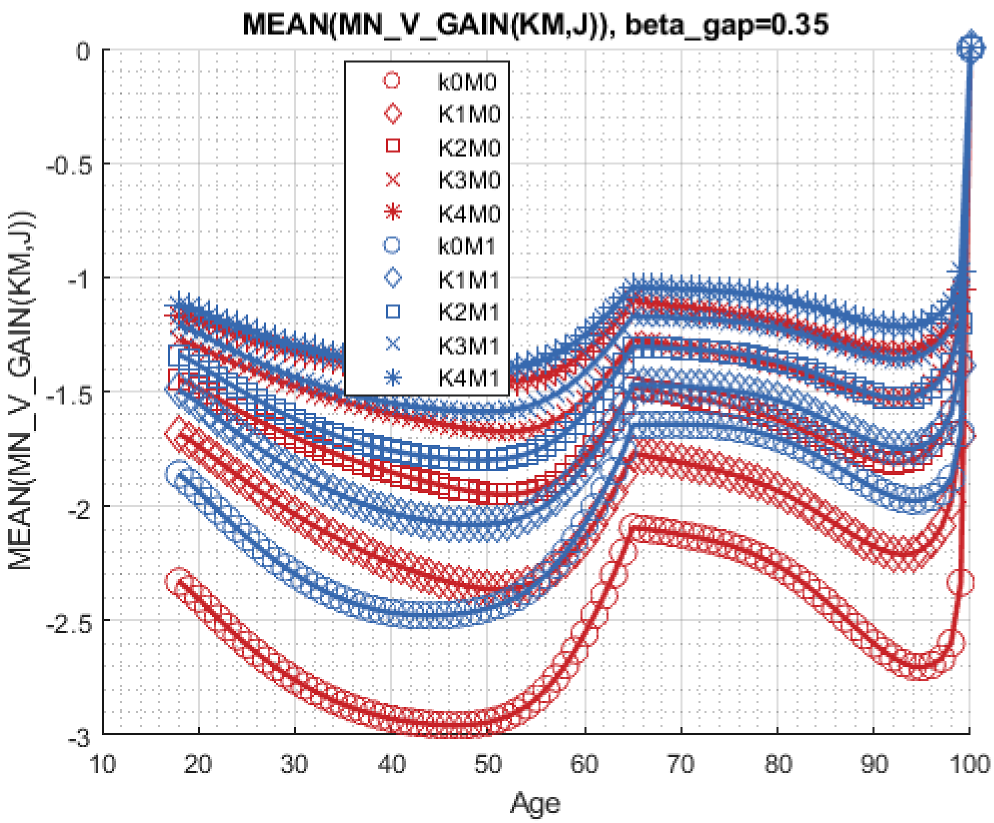
xxx MEAN(MN_C_Gain(KM,J)), beta_gap=0.35 xxxxxxxxxxxxxxxxxxxxxxxxxxx

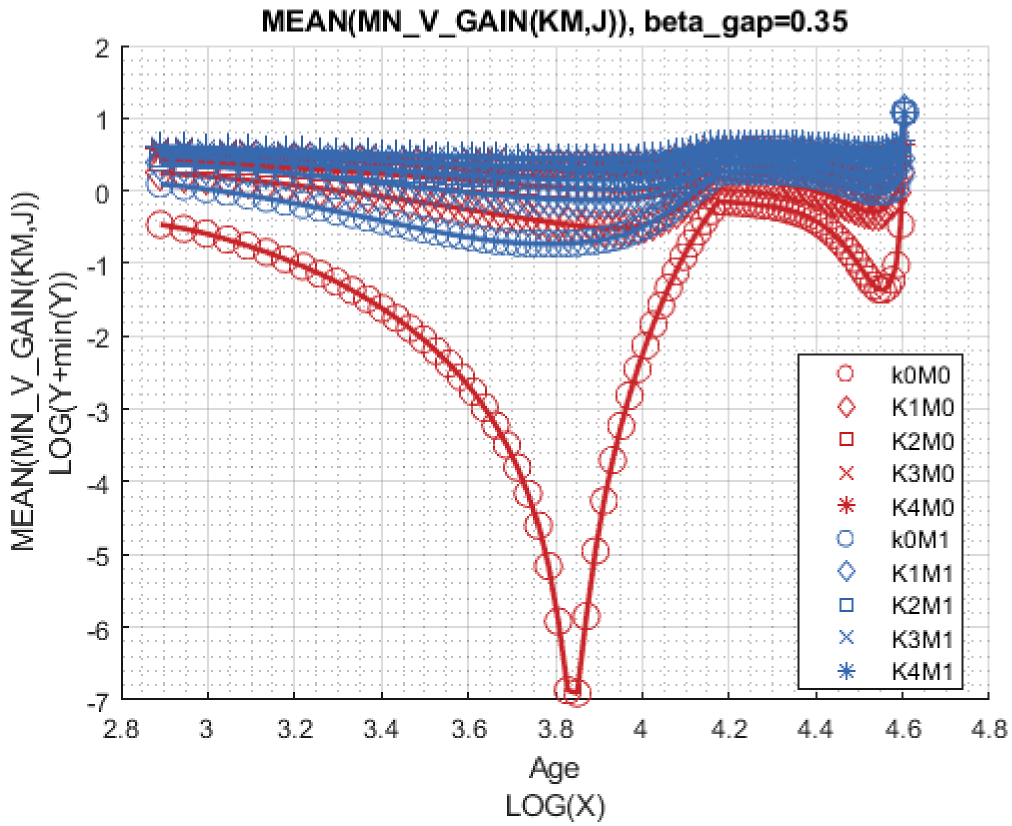
group	kids	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_22	mean_age_23
1	1	0	-7.8284	-7.878	-7.942	-8.0313	-8.1185	-8.2037
2	2	0	-7.7474	-7.7919	-7.8514	-7.9374	-8.0227	-8.1073
3	3	0	-7.8502	-7.8841	-7.9298	-8.0042	-8.0781	-8.1507
4	4	0	-7.8498	-7.8791	-7.9197	-7.989	-8.0577	-8.125
5	5	0	-7.882	-7.9053	-7.9401	-8.0028	-8.0648	-8.1254
6	1	1	-8.3054	-8.3892	-8.4885	-8.6164	-8.7429	-8.8684

7	2	1	-8.1032	-8.1784	-8.2681	-8.3867	-8.5041	-8.6209
8	3	1	-8.1357	-8.2006	-8.2817	-8.3905	-8.4971	-8.6037
9	4	1	-8.0781	-8.1343	-8.207	-8.3071	-8.4058	-8.5037
10	5	1	-8.051	-8.0944	-8.154	-8.2396	-8.3246	-8.4088

Graph Mean Values:

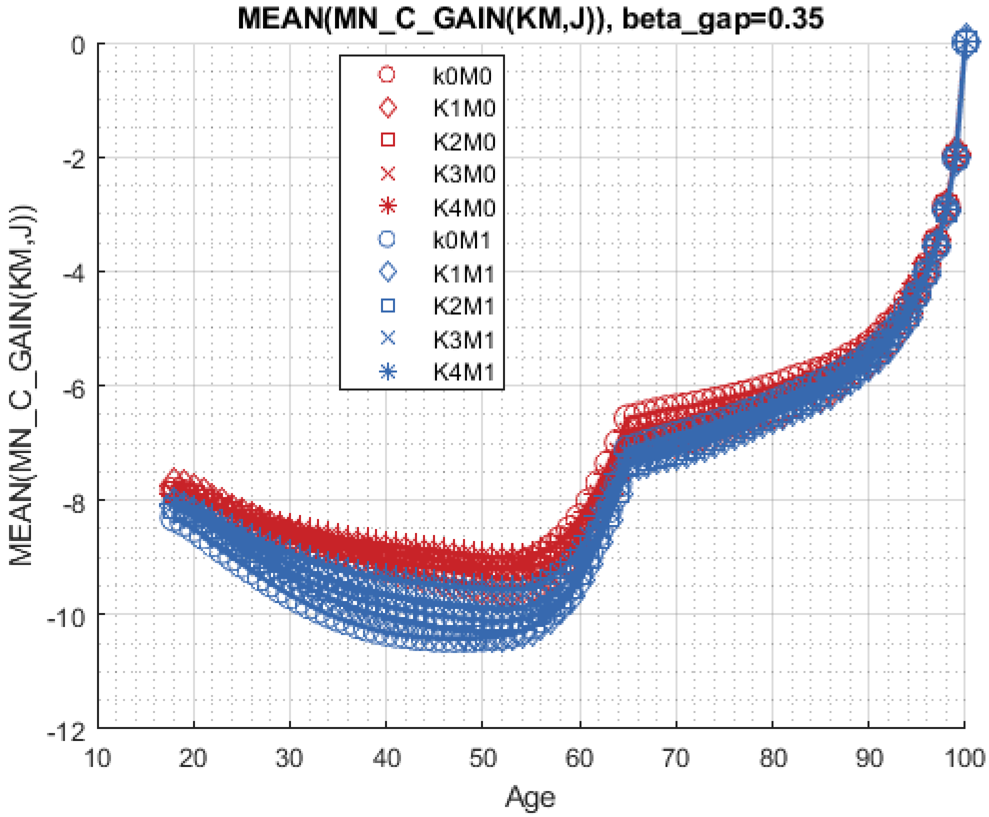
```
st_title = ['MEAN(MN\_V\_GAIN(KM,J)), beta\_gap=' num2str(fl_beta_gap)  ''];
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_GAIN(KM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

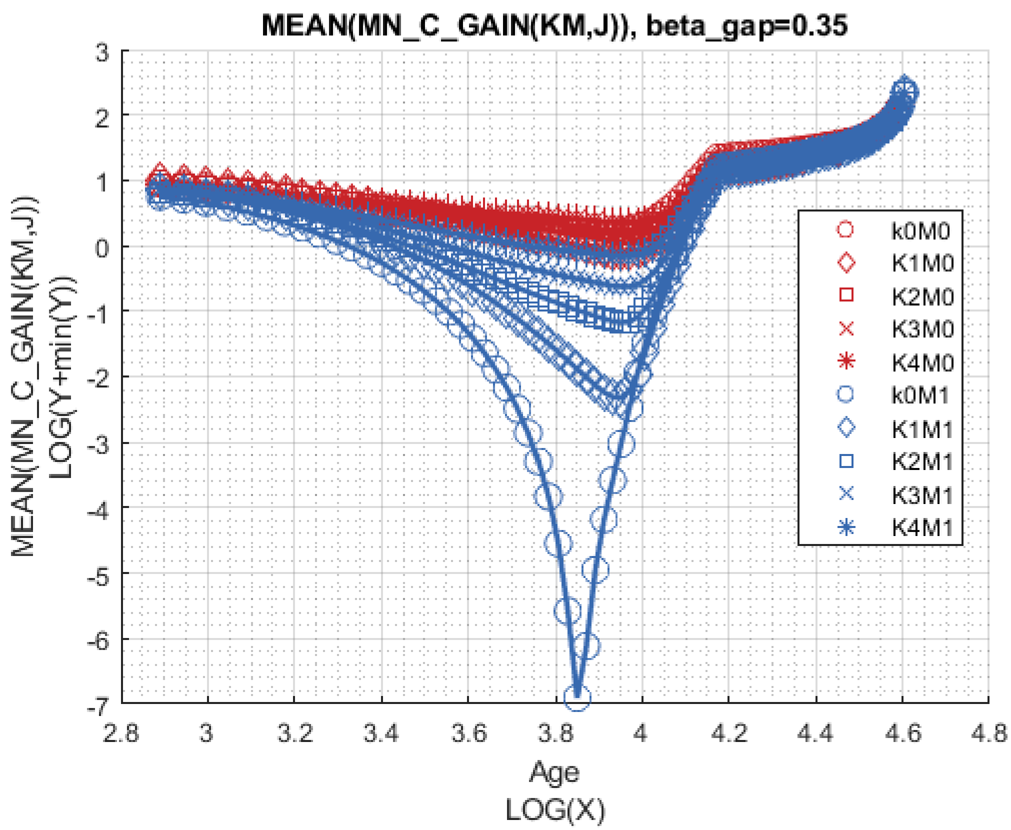




Graph Mean Consumption:

```
st_title = ['MEAN(MN\_C\_GAIN(KM,J)), beta\_gap=' num2str(fl_beta_gap)  ''];
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_C\_GAIN(KM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```





Analyze Education and Marriage

Aggregating over education, savings, and shocks, what are the differential effects of Marriage and Age.

```
% Generate some Data
mp_support_graph = containers.Map('KeyType', 'char', 'ValueType', 'any');
ar_row_grid = ["E0M0", "E1M0", "E0M1", "E1M1"];
mp_support_graph('cl_st_xtitle') = {'Age'};
mp_support_graph('st_legend_loc') = 'best';
mp_support_graph('bl_graph_logy') = true; % do not log
mp_support_graph('st_rounding') = '6.2f'; % format shock legend
mp_support_graph('cl_scatter_shapes') = {'*', 'p', '*','p' };
mp_support_graph('cl_colors') = {'red', 'red', 'blue', 'blue'};
```

MEAN(VAL(EM,J)), MEAN(AP(EM,J)), MEAN(C(EM,J))

Tabulate value and policies:

```
% Set
% NaN(n_jgrid,n_agrid,n_etagrid,n_educgrid,n_marriedgrid,n_kidsgrid);
ar_permute = [2,3,6,1,4,5];
% Value Function
st_title = ['MEAN(MN_V_Gain(EM,J)), beta_gap=' num2str(fl_beta_gap) ];
tb_az_v = ff_summ_nd_array(st_title, mn_V_gain_beta, true, ["mean"], 3, 1, cl_mp_datasetdesc, a
```

xxx MEAN(MN_V_Gain(EM,J)), beta_gap=0.35 xxxxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_22	mean_age_23
1	0	0	-1.5742	-1.5897	-1.6068	-1.6259	-1.6446	-1.6629
2	1	0	-1.5882	-1.613	-1.642	-1.6763	-1.7098	-1.7425
3	0	1	-1.3891	-1.4066	-1.4256	-1.4464	-1.4669	-1.4869
4	1	1	-1.421	-1.4478	-1.4783	-1.5137	-1.5485	-1.5826

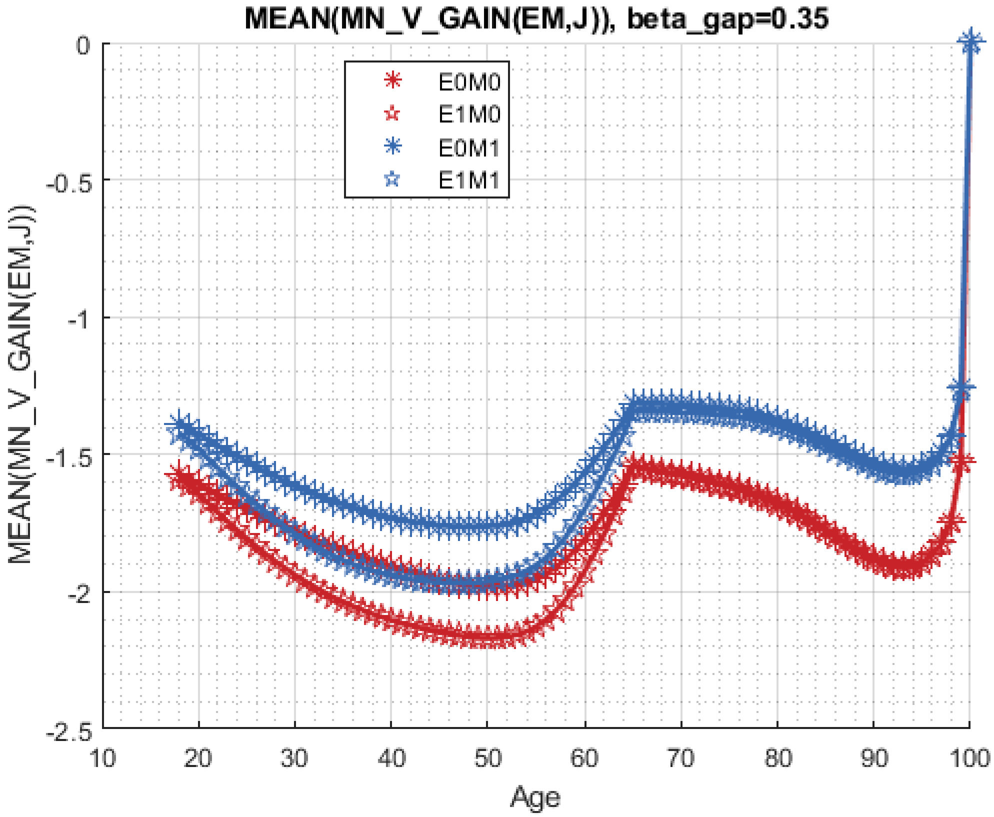
```
% Consumption
st_title = ['MEAN(MN_C_Gain(EM,J)), beta_gap=' num2str(fl_beta_gap) ];
tb_az_c = ff_summ_nd_array(st_title, mn_C_gain_beta, true, ["mean"], 3, 1, cl_mp_datasetdesc, a
```

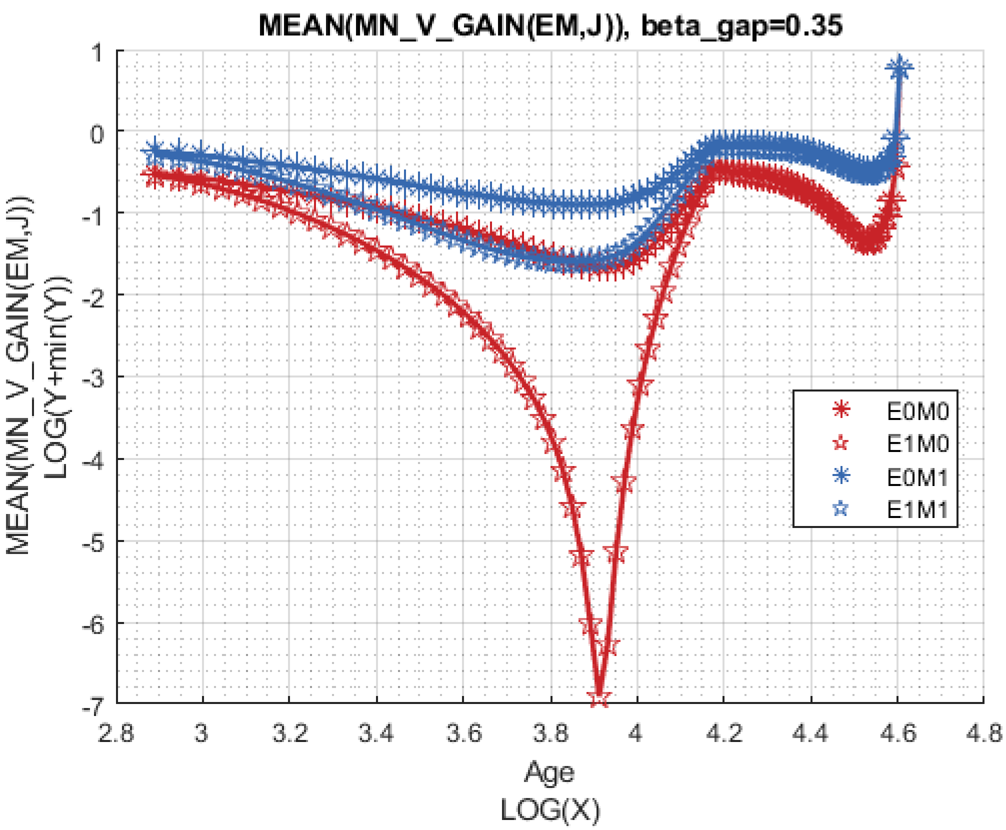
xxx MEAN(MN_C_Gain(EM,J)), beta_gap=0.35 xxxxxxxxxxxxxxxxxxxxxxxxxxxxx

group	edu	marry	mean_age_18	mean_age_19	mean_age_20	mean_age_21	mean_age_22	mean_age_23
1	0	0	-7.8968	-7.9208	-7.9537	-8.0028	-8.0505	-8.0966
2	1	0	-7.7663	-7.8145	-7.8794	-7.983	-8.0863	-8.1882
3	0	1	-8.1784	-8.2294	-8.2887	-8.3652	-8.4396	-8.5134
4	1	1	-8.091	-8.1694	-8.2711	-8.4109	-8.5502	-8.6888

Graph Mean Values:

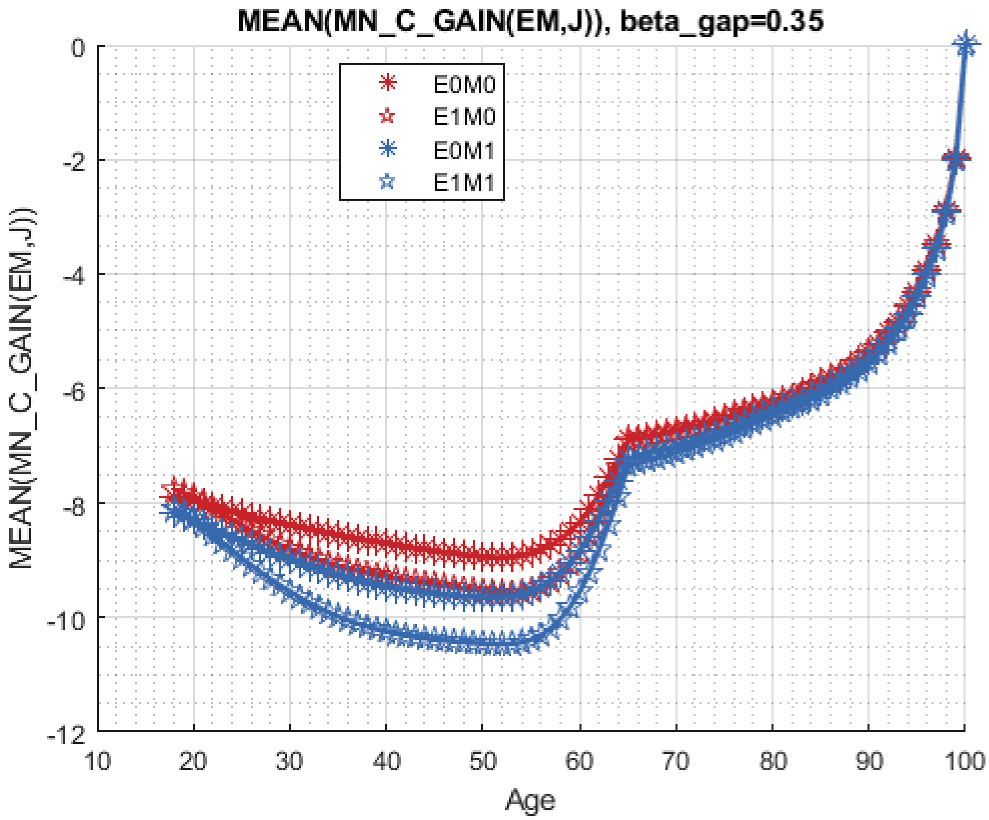
```
st_title = ['MEAN(MN\_V\_GAIN(EM,J)), beta\_gap=' num2str(fl_beta_gap)  ''];
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_V\_GAIN(EM,J))'};
ff_graph_grid((tb_az_v{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```

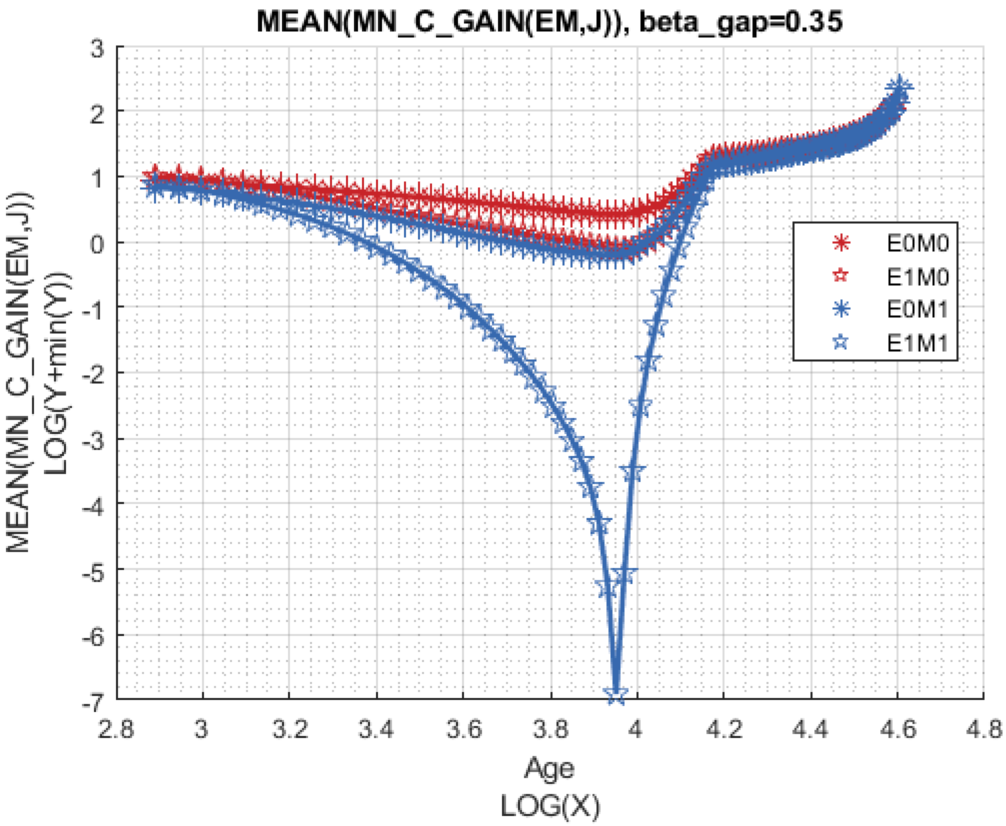




Graph Mean Consumption:

```
st_title = ['MEAN(MN\_C\_GAIN(EM,J)), beta\_gap=' num2str(fl_beta_gap)  ''];
mp_support_graph('cl_st_graph_title') = {st_title};
mp_support_graph('cl_st_ytitle') = {'MEAN(MN\_C\_GAIN(EM,J))'};
ff_graph_grid((tb_az_c{1:end, 4:end}), ar_row_grid, age_grid, mp_support_graph);
```




MEAN(MN_C_GAIN(EM,J)), beta_gap=0.35
MEAN(MN_C_GAIN(EM,J))
LOG(Y+min(Y))
Age
LOG(X)
E0M0
E1M0
E0M1
E1M1
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8