```
% This script file computes the optimal investment levels TAopt and
 TBopt
% for the two firms (Firm A and Firm B) of the Simplified
 Oligopolistic
% Optimal Influence model which also involves a single consumer C. The
 rest
% of the model parameters (Sopt,Xopt,Popt,Qopt,Fopt) are also
 computed.

% Specifically, the internal model parameters whose optimal values are
 to
% be determined during the grid searching optimization process are the
% follwing:
% (i):   [TAopt,TBopt]
% (ii):  [SAopt,SCopt,SBopt]
% (iii): [XAopt,XBopt]
% (iv):  [PAopt,PBopt] (These are the optimal prices!!!)
% (v):   [QAopt,QBopt]
% (vi):  [FAopt FBopt FA_rev_opt FB_rev_opt FA_cost_opt FB_rev_opt]

% The grid searching process will be conducted within the 8-
dimensional
% space defined by the Cartesian product of the following external
 model
% parameters:
% (i):    LA (direct influnce exerted by consumer C on Firm A).
% (ii):   LB (direct influnce exerted by consumer C on Firm B).
% (iii):  PA (initial belief consumer C holds for product A).
% (iv):   PB (initial belief consumer C holds for product B).
% (v):    M  (sensitivity coefficient).
% (vi):   K  (sensitivity coefficient).
% (vii):  C  (marginal cost).
% (viii): G  (marginal influence cost or Gamma).

% IMPORTANT NOTE!!!
% Mind that the underlying continuous game may not have an equlibrium
 point
% for any given configuration of the external parameters. Since all
 the
% internal parameters to be determined accept positive values, the
 value of
% (-1) will be utilized in order to indicate the absence of an
 equilibrium
% point for a particular configuration of the external parameters.

% Define ranges and corresponding increment step for each external
 parameter
% of the Simplified Oligopolistic Optimal Influence model.

clc
clear
```

```
% Construct a cell array storing the names of model parameters.
ParamsNames = {'LA','LB','PA','PB','M','K','C','G'};

% Set the varying parameter index.
ParamIndex = 5;

% Parameter #1
LA_MIN = 0.50;
LA_MAX = 0.50;
LA_STEP = 0.01;
% Parameter #2
LB_MIN = 0.50;
LB_MAX = 0.50;
LB_STEP = 0.01;
% Parameter #3
PA_MIN = 0.40;
PA_MAX = 0.40;
PA_STEP = 0.01;
% Parameter #4
PB_MIN = 0.40;
PB_MAX = 0.40;
PB_STEP = 0.01;
% Parameter #5
M_MIN = 0.00;
M_MAX = 1.00;
M_STEP = 0.01;
% Parameter #6
K_MIN = 0.50;
K_MAX = 0.50;
K_STEP = 0.01;
% Parameter #7
C_MIN = 0.0;
C_MAX = 0.0;
C_STEP = 0.01;
% Parameter #8 (G or Gamma!!!)
% G = 0.2; % Mind that G is the Gamma parameter defined elsewhere.
% Determine the minimum value for G.
alpha0 = (K_MAX*M_MAX - 2) / (M_MIN^2 - 4);
beta0 = (2*K_MAX - M_MIN) / (M_MIN^2 - 4);
Fmax = max(alpha0^2,(3*beta0^2+2*alpha0*beta0));
Lmin = min(LA_MIN,LB_MIN);
G0 = Fmax  / (Lmin^2);
Gfraction = 1.50; % This value should be set to 1.
G0 = Gfraction * G0;
G_MIN = G0;
G_MAX = G0;
G_STEP = 1.00;
% G_STEP = (G_MAX - G_MIN)/1000;

% Set the corresponding ranges for each parameter of the model.
LA_RANGE = LA_MIN:LA_STEP:LA_MAX;
LB_RANGE = LB_MIN:LB_STEP:LB_MAX;
PA_RANGE = PA_MIN:PA_STEP:PA_MAX;
PB_RANGE = PB_MIN:PB_STEP:PB_MAX;
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M_RANGE = M_MIN:M_STEP:M_MAX;
K_RANGE = K_MIN:K_STEP:K_MAX;
C_RANGE = C_MIN:C_STEP:C_MAX;
G_RANGE = G_MIN:G_STEP:G_MAX;

% Initialize matrices that store fundamental intermediate quantities
 of the
% underlying optimization problem within the simplified oligopolistic
% enviroment as well as the values of the external optimization
 parameters
% for each step of the multi-dimensional grid searching process.
Topts = []; % Optimal investment levels.
Sopts = []; % Optimal limiting influences.
Xopts = []; % Optimal limiting beliefs.
Popts = []; % Optimal prices.
Qopts = []; % Optimal quantities.
Fopts = []; % Optimal profits.
FilterFlags = []; % Solution filtering flag which may be indicative of
 a non-existing solution.
DigitAccuracies = []; % Length of maximal sequence of identical digits
 within the obtained optimal solutions.
Params = []; % 8-tuple of the varying optimization parameters.

% Initialize internal solver parameters.
% Set the number of initial solution points.
N = 2000;
% Set the tolerance value for the minimizer. (Preferable value =
 1e-10)
Tolerance = 1e-15;
% Set the Fvals tolerance value for filtering the obtained solutions.
 (Preferable value = 1e-15)
FvalsTolerance = 1e-15;
% Set the derivative tolerance value for filering the obtained
 solutions. (Preferable value = 1e-08).
DerivativeTolerance = 1e-08;
% Set the maximum number of iterations to be conducted by the
 optimizer.
MaxIterations = 2000;
% Set the maximum number of function evaluations to be conducted by
 the
% optimizer.
MaxFunctionEvaluations = 20000;
% Set the display flag parameter to 'off' or to 'iter'.
DisplayFlag = 'off';
% Set the minimum digits accuracy.
MinimumDigitsAccuracy = 7;

fprintf('Grid Evaluation Process in Progess...\n');
% Perform the actual grid searching.
for LA = LA_RANGE
    for LB = LB_RANGE
        for PA = PA_RANGE
            for PB = PB_RANGE
                for M = M_RANGE
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```
                    for K = K_RANGE
                        for C = C_RANGE
                            for G = G_RANGE
                                % Additional parameters definition.
                                alpha = (K*M - 2) / (M^2 - 4);
                                beta = (2*K - M) / (M^2 - 4);
                                gamma = C / (M - 2);
                                gamma_prime = gamma * (M - 1); %
gamma_prime is the gamma' parameter.
                                % Set the current params vector.
                                params = [LA LB PA PB M K C G];
                                Params = [Params;params];

[TAopt,TBopt,FilterFlag,DigitsAccuracy] =
SimplifiedOligopolisticOptimalInfluences(N,DisplayFlag,Tolerance,FvalsTolerance,D
                                DigitsAccuracy = min(DigitsAccuracy);
                                T = [TAopt TBopt];
                                if(FilterFlag==0)
                                    [S,X,P,Q,F] =
RetrieveOptimalModelParameters(T,C,G,LA,LB,PA,PB,alpha,beta,gamma,gamma_prime);
                                else
                                    S = -1*ones(1,3);
                                    X = -1*ones(1,2);
                                    P = -1*ones(1,2);
                                    Q = -1*ones(1,2);
                                    F = -1*ones(1,6);
                                end
                                    % Print current solution.
                                param_value_string
= strcat([ParamsNames{ParamIndex} ' = '
num2str(params(ParamIndex),10)]);
                                fprintf('%s TAopt =
 %f TBopt = %f FilterFlag = %d DigitsAccuracy = %d
\n',param_value_string,TAopt,TBopt,FilterFlag,DigitsAccuracy);
                                Topts = [Topts;T];
                                FilterFlags =
[FilterFlags;FilterFlag];
                                DigitsAccuracies =
[DigitAccuracies;DigitsAccuracy];
                                Sopts = [Sopts;S];
                                Xopts = [Xopts;X];
                                Popts = [Popts;P];
                                Qopts = [Qopts;Q];
                                Fopts = [Fopts;F];
                            end
                        end
                    end
                end
            end
        end
    end
end
```

```
% Set parameters' indices and corresponding values for the parameters
 that
% remain constant.
ConstIndices = setdiff(1:length(params),ParamIndex);
ConstValues = params(ConstIndices);
% Perform plotting operations.
PlotParametersTuples(Topts,Sopts,Xopts,Popts,Qopts,Fopts,Params,ParamIndex,ConstIn
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```
Grid Evaluation Process in Progess...
M = 0 TAopt = 0.075856 TBopt = 0.075856 FilterFlag = 0 DigitsAccuracy
 = 8
M = 0.01 TAopt = 0.075889 TBopt = 0.075889 FilterFlag = 0
 DigitsAccuracy = 8
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 DigitsAccuracy = 8
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 DigitsAccuracy = 8
```

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 DigitsAccuracy = 9
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 DigitsAccuracy = 9
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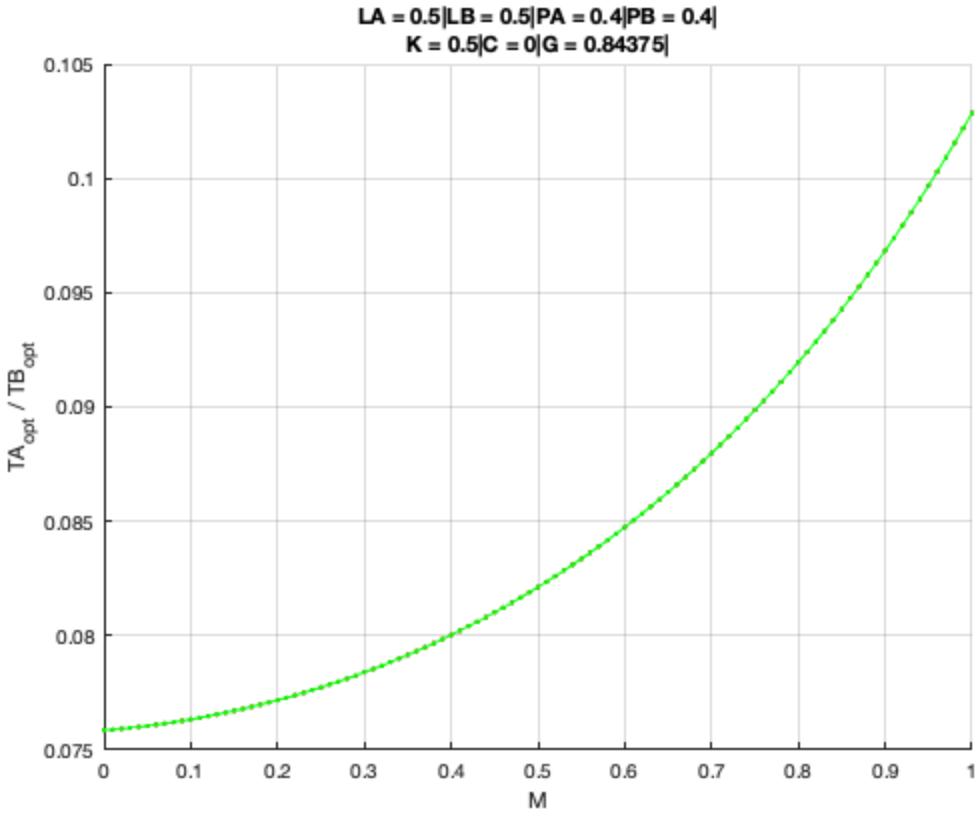
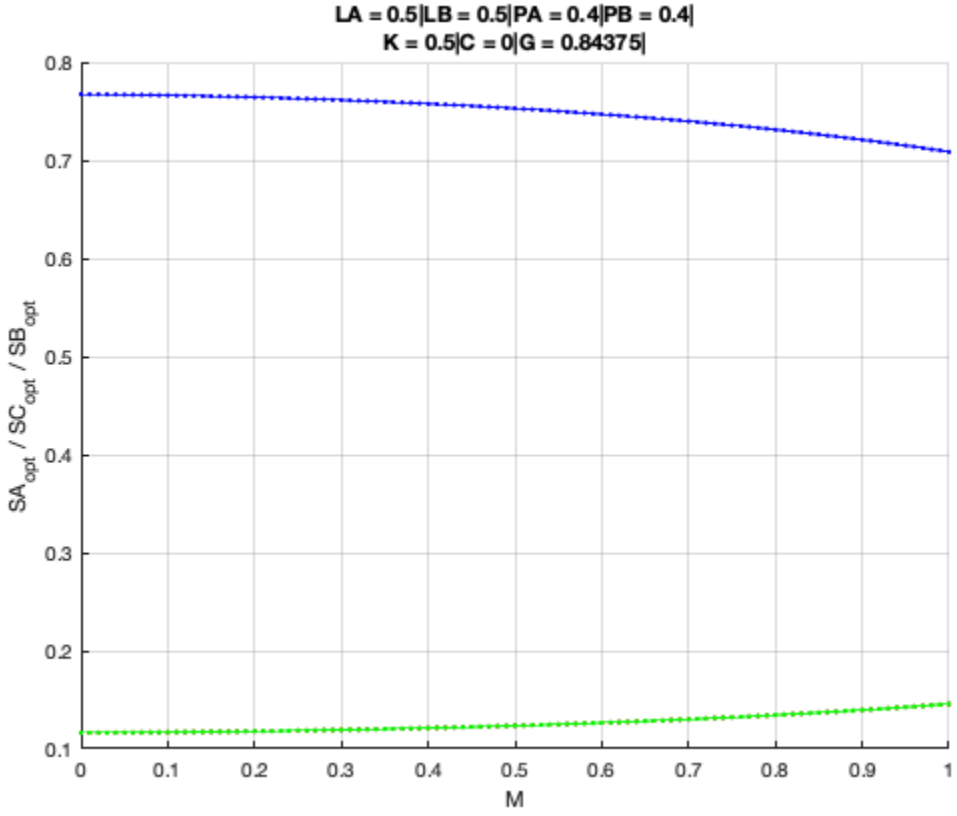
 = 9
```


LA = 0.5|LB = 0.5|PA = 0.4|PB = 0.4|
K = 0.5|C = 0|G = 0.84375|
TA_opt / TB_opt
M
0.105
0.1
0.095
0.09
0.085
0.08
0.075
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1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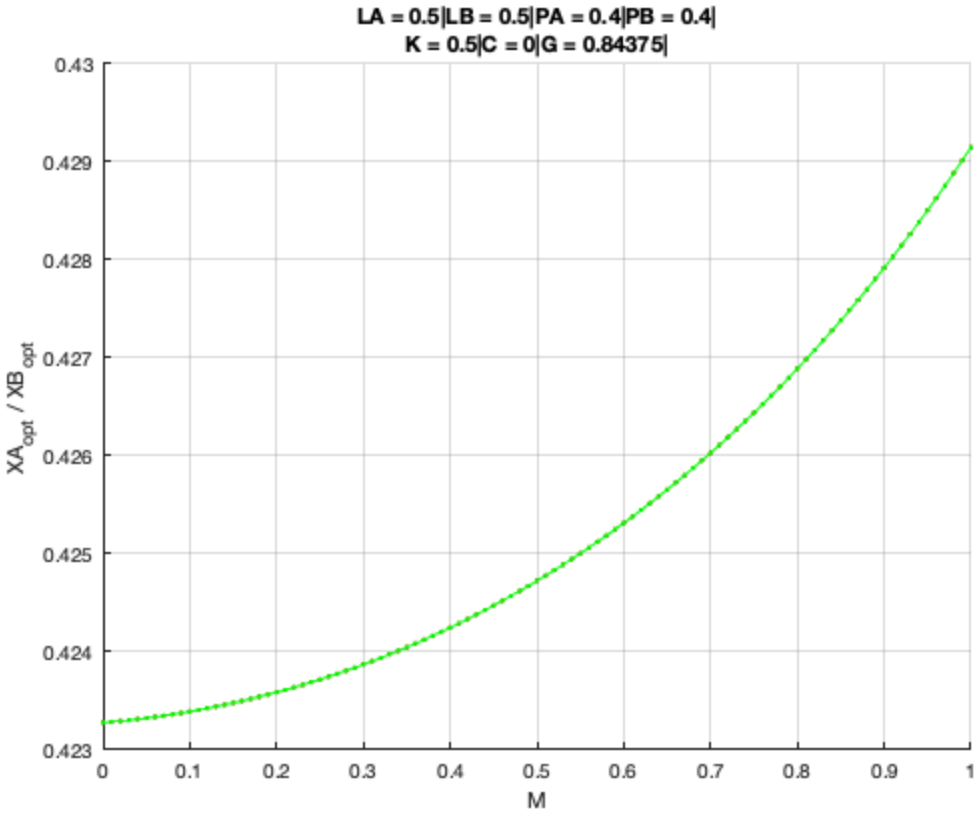
K = 0.5|C = 0|G = 0.84375|
SA_opt / SC_opt / SB_opt
M
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1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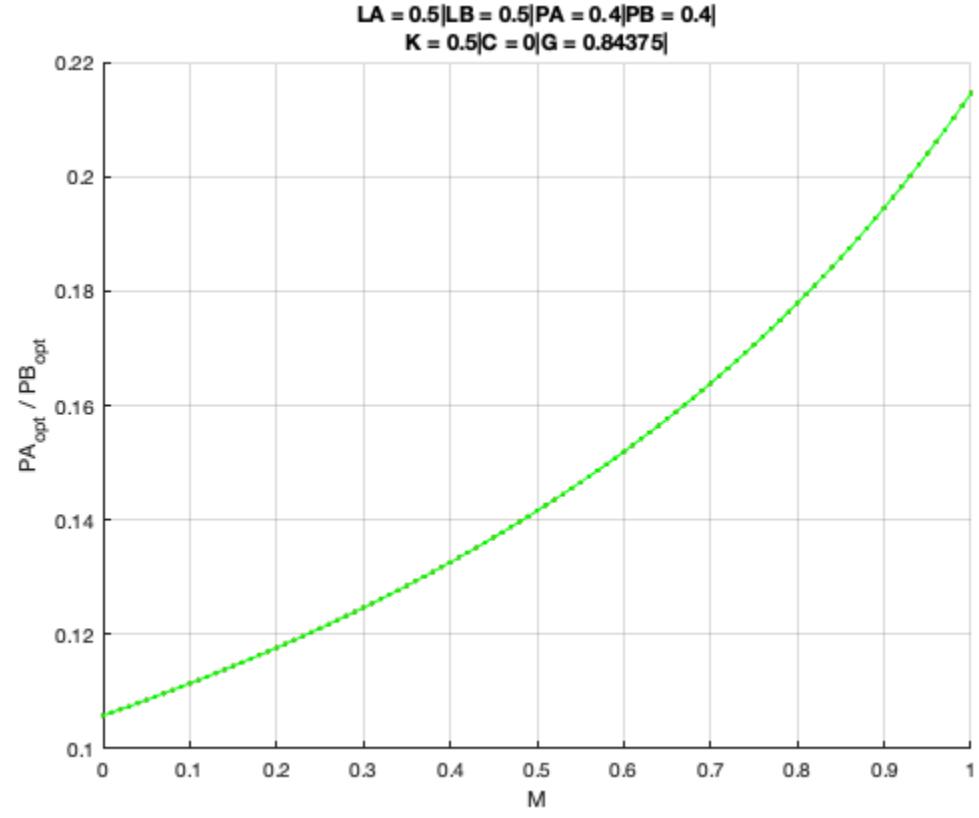
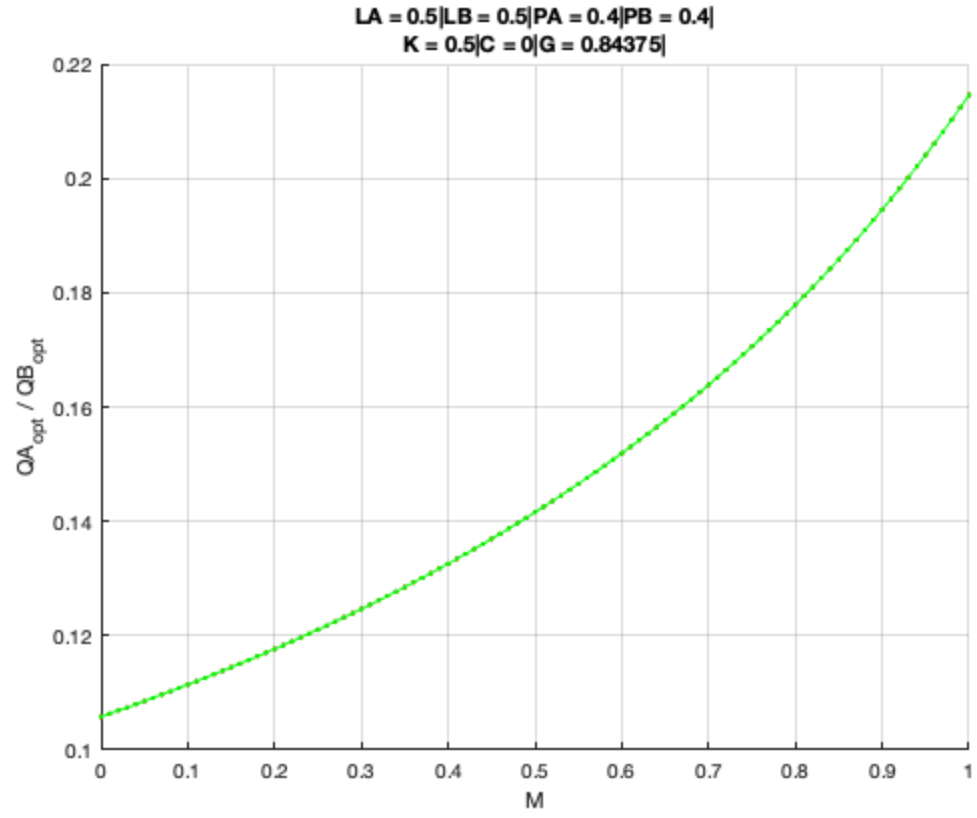
K = 0.5|C = 0|G = 0.84375|
XA_opt / XB_opt
M
0.43
0.429
0.428
0.427
0.426
0.425
0.424
0.423
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


LA = 0.5|LB = 0.5|PA = 0.4|PB = 0.4|
K = 0.5|C = 0|G = 0.84375|
PA_opt / PB_opt
M
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1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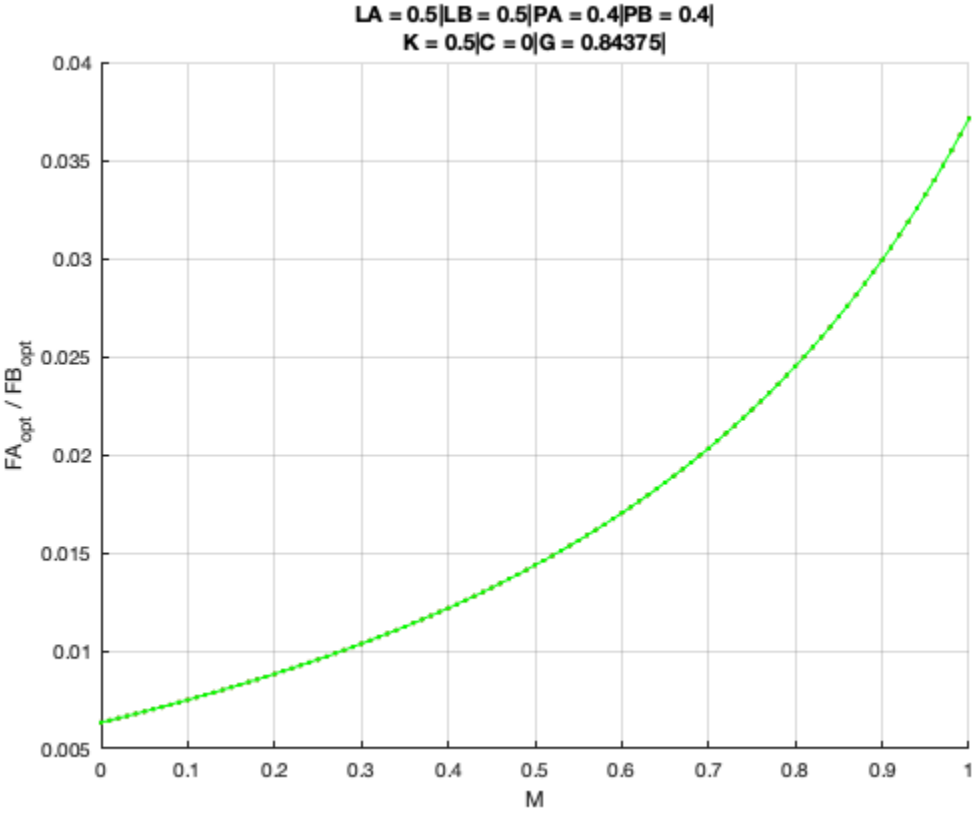
K = 0.5|C = 0|G = 0.84375|
QA_opt / QB_opt
M
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1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K = 0.5|C = 0|G = 0.84375|
FA_opt / FB_opt
M
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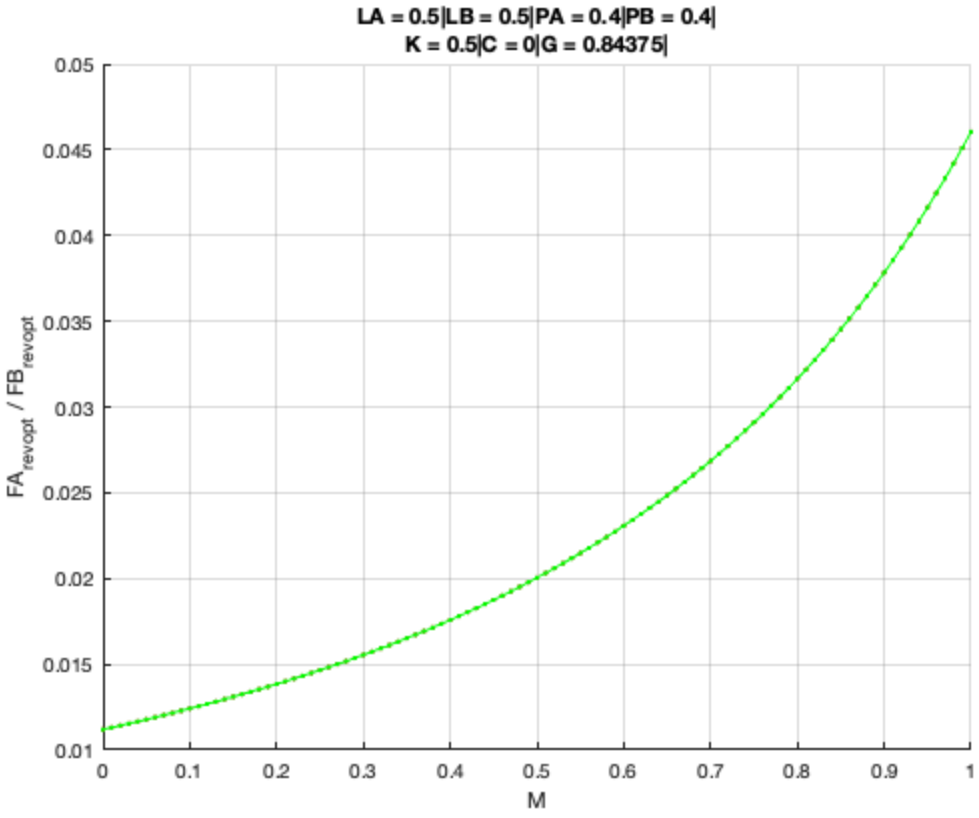
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1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FA_revopt / FB_revopt
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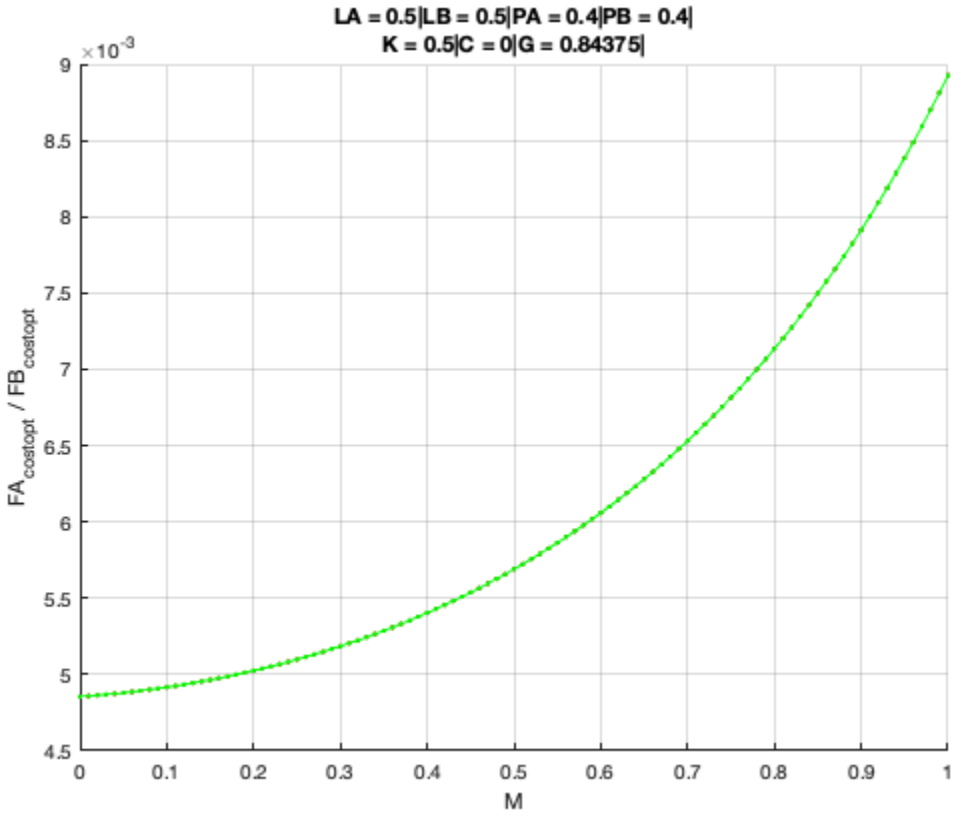
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1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×10^-3
FA_costopt / FB_costopt
M
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

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