Simulate Permanent Change in Inflation Target

simulate_disinflation.m

by Jaromir Benes

May 27, 2015

Summary

Simulate a permanent change in the inflation target, calculate the sacrifice ratio, and run a simple parameter sensitivity exercise using model objects with multiple parameterizations.

Contents

1 Clear Workspace

Clear workspace, close all graphics figures, clear command window, and check the IRIS version.

```
clear;
close all;
clc;
irisrequired 20140315;
%#ok<*NASGU>
%#ok<*NOPTS>
```

2 Load Solved Model Object

Load the solved model object built in `read_model`; run `read_model` at least once before running this m-file.

```
load read_model.mat m;
```

3 Define dates

```
startDate = qq(2009,2);
endDate = startDate + 39;
plotRng = startDate-5 : startDate+19;
```

4 Create Model with Higher Steady State Inflation

Set the steady-state rate of inflation to 3 pct, and solve for the new steady state of nominal variables. Real variables remain unchanged, so they can be fixed here.

```
m1 = m;
m1.pi = 1.035^(1/4);
m1 = sstate(m1,'fix=',{'Y','N','A','RMC','Growth'},'growth=',true);
chksstate(m1);
m1 = solve(m1)

ss = get(m,'sstateLevel');
ss1 = get(m1,'sstateLevel');
ss & ss1
```

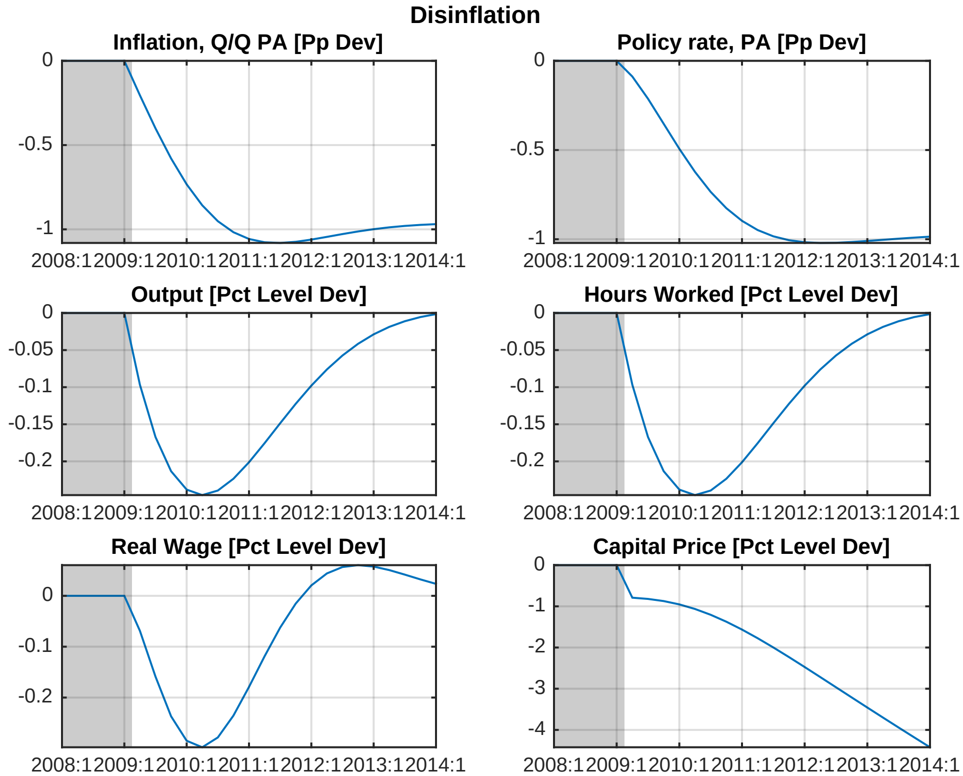
```
                                         First-Order                    Norm of
 Iteration  Func-count    Residual       optimality      Lambda           step
     0           23     0.000212136            0.103        0.01
     1           46     6.66933e-09         0.000506       0.001      0.0120627
     2           69     1.03342e-12         4.45e-08      0.0001     8.3589e-05
     3           92     2.28258e-13         4.61e-09       1e-05     5.0535e-05
     4          115     1.53773e-15         3.81e-10       1e-06    4.14635e-05
     5          138     1.20788e-19         3.38e-12       1e-07     3.6748e-06
     6          161     9.63814e-26         3.18e-14       1e-08    3.28311e-08
     7          184     2.97031e-30         1.94e-14       1e-09    2.93497e-11

Local minimum possible.

lsqnonlin stopped because the relative size of the current step is less than
the selected value of the step size tolerance.




                                         First-Order                    Norm of
 Iteration  Func-count    Residual       optimality      Lambda           step
     0            7         6.30872             10.5        0.01
     1           14     0.000309159           0.0104       0.001        1.75847
     2           21     3.14767e-10         1.03e-05      0.0001      0.0176528
     3           28     3.21098e-18         1.04e-09       1e-05    1.78292e-05
     4           35     3.31519e-28         1.07e-14       1e-06    1.80093e-09
     5           42               0                0       1e-07    1.82985e-14

Local minimum found.

Optimization completed because the size of the gradient is less than
the selected value of the function tolerance.



m1 =
        nonlinear model object: [1] parameterisation(s)
        number of equations: [4 15 4 0 0]
        solution(s) available: [1] parameterisation(s)
        comment: 'Simple Sticky Price Business Cycle Model'
        user data: empty
        export files: [0]

ans =
```

```
     Short: [7.1827 8.2284]
      Infl: [2.5000 3.5000]
    Growth: [3.0000 3.0000]
      Wage: [5.5750 6.6050]
         Y: [1.5519 1.5519]
         N: [0.7470 0.7470]
         W: [1.7314 1.7314]
         Q: [0.8333 0.8333]
         H: [1.5519 1.5519]
         A: [1.0000 1.0000]
         P: [1 1.0000]
         R: [1.0175 1.0200]
        Pk: [1.5312 1.5312]
        Rk: [0.0517 0.0517]
    Lambda: [0.6444 0.6444]
        dP: [1.0062 1.0086]
       d4P: [1.0250 1.0350]
        dW: [1.0137 1.0161]
       RMC: [0.8333 0.8333]
        Mp: [0 0]
        Mw: [0 0]
        Ey: [0 0]
        Ep: [0 0]
        Ea: [0 0]
        Er: [0 0]
        Ew: [0 0]
     alpha: [1.0074 1.0074]
      beta: [0.9962 0.9962]
     gamma: [0.6000 0.6000]
     delta: [0.0300 0.0300]
         k: [10 10]
        pi: [1.0062 1.0086]
       eta: [6 6]
       psi: [0.2500 0.2500]
       chi: [0.8500 0.8500]
       xiw: [60 60]
       xip: [300 300]
      rhoa: [0.9000 0.9000]
      rhor: [0.8500 0.8500]
    kappap: [3.5000 3.5000]
    kappan: [0 0]
    Short_: [0 0]
     Infl_: [0 0]
   Growth_: [0 0]
     Wage_: [0 0]
```

5 Simulate Disinflation

Simulate the low-inflation model, `m`, starting from the steady state of the high-inflation model, `m1`.

```
d1 = sstatedb(m1,startDate-3:endDate);
s = simulate(m,d1,startDate:endDate);
s = dboverlay(d1,s);
s = dbminuscontrol(m,s,d1);

plotList = { ...
    ' "Inflation, Q/Q PA [Pp Dev]" dP^4 ', ...
        ' "Policy rate, PA [Pp Dev]" R^4 ', ...
    ' "Output [Pct Level Dev]" Y ', ...
    ' "Hours Worked [Pct Level Dev]" N ', ...
    ' "Real Wage [Pct Level Dev]" W/P ', ...
    ' "Capital Price [Pct Level Dev]" Pk', ...
   };
dbplot(s,plotRng,plotList, ...
   'tight=',true,'highlight=',startDate-5:startDate-1, ...
   'transform=',@(x) 100*(x-1));
grfun.ftitle('Disinflation');
```



6 Sacrifice Ratio

Sacrifice ratio is the cumulative output loss after a 1% PA disinflation. Divide by 4 to get an annualised figure (reported in the literature).

```
sacRat = -cumsum(100*(s.Y-1))/4
```

```
sacRat =
        tseries object: 47-by-1
        2007Q3:         0
        2007Q4:         0
        2008Q1:         0
        2008Q2:         0
        2008Q3:         0
        2008Q4:         0
        2009Q1:         0
        2009Q2:   0.02419
        2009Q3:  0.065988
```

```
    2009Q4:    0.1193
    2010Q1:   0.17882
    2010Q2:   0.24018
    2010Q3:   0.30001
    2010Q4:   0.35586
    2011Q1:   0.40616
    2011Q2:   0.45003
    2011Q3:   0.48718
    2011Q4:   0.51777
    2012Q1:   0.54225
    2012Q2:   0.56128
    2012Q3:    0.5756
    2012Q4:   0.58598
    2013Q1:   0.59317
    2013Q2:   0.59785
    2013Q3:   0.60063
    2013Q4:   0.60199
    2014Q1:   0.60237
    2014Q2:    0.6021
    2014Q3:   0.60141
    2014Q4:   0.60052
    2015Q1:   0.59954
    2015Q2:   0.59858
    2015Q3:   0.59769
    2015Q4:    0.5969
    2016Q1:   0.59624
    2016Q2:   0.59569
    2016Q3:   0.59526
    2016Q4:   0.59493
    2017Q1:    0.5947
    2017Q2:   0.59454
    2017Q3:   0.59444
    2017Q4:   0.59438
    2018Q1:   0.59436
    2018Q2:   0.59437
    2018Q3:   0.59439
    2018Q4:   0.59443
    2019Q1:   0.59446
    'Output'
    user data: empty
    export files: [0]
```

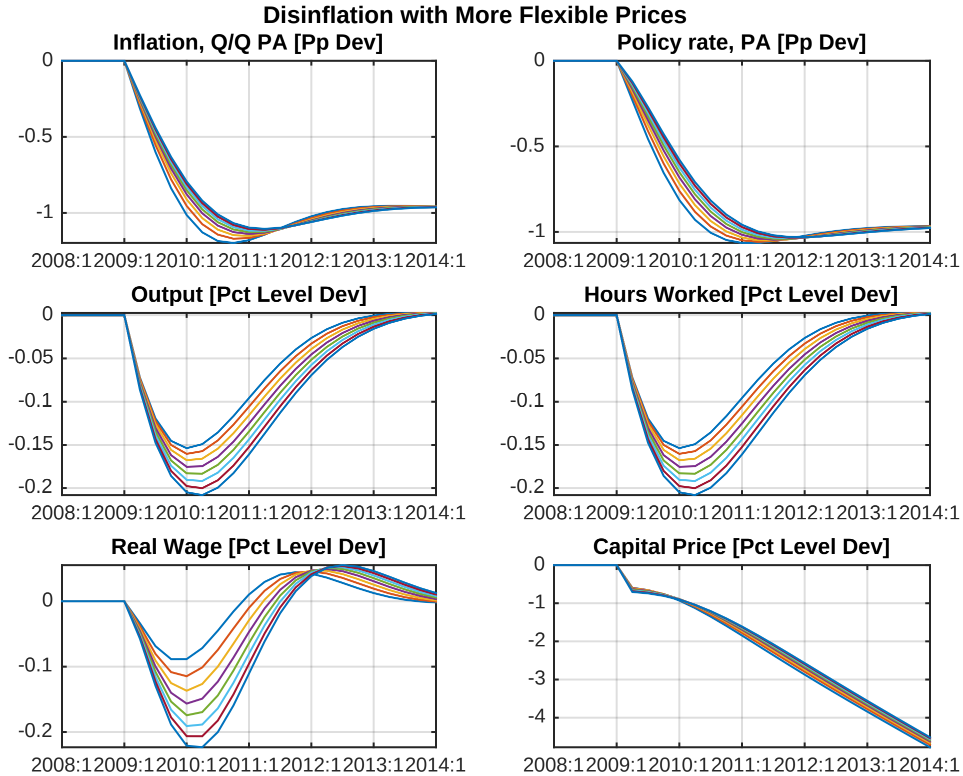
7 Change Price and Wage Stickiness and Compare to Baseline

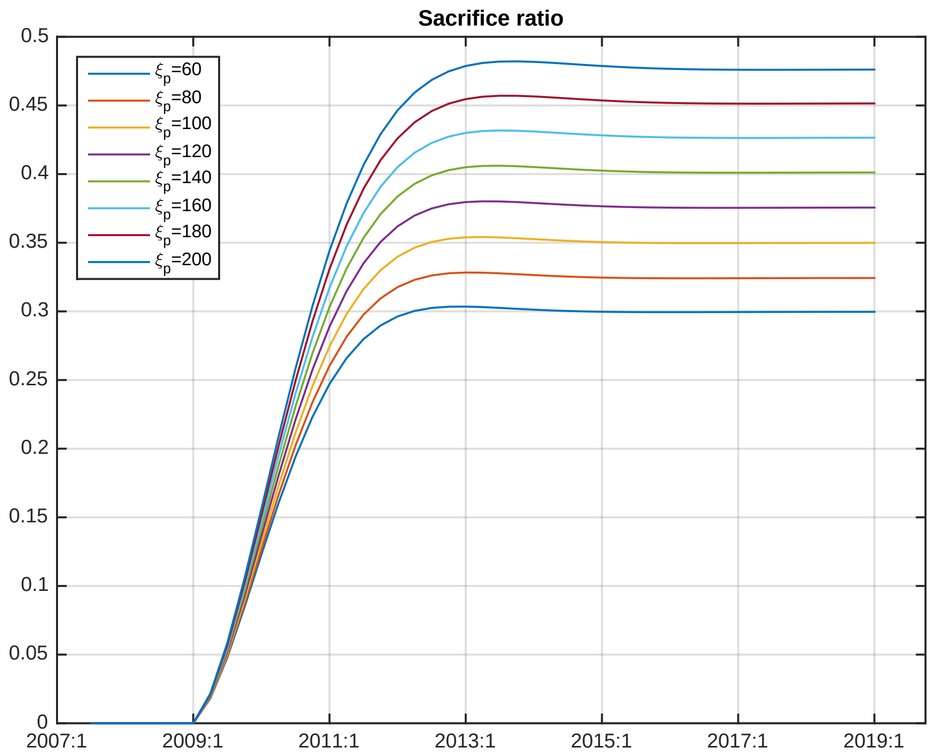
Create a model object with 8 parameterisations, and assign a range of values to the price stickiness parameter.

```
m(1:8) = m;
m.xip = [60,80,100,120,140,160,180,200];
m = solve(m)

s = simulate(m,d1,startDate:endDate);
s = dboverlay(d1,s);
s = dbminuscontrol(m,s,d1);

dbplot(s,plotRng,plotList,'tight=',true,'transform=',@(x) 100*(x-1));
grfun.ftitle('Disinflation with More Flexible Prices');

disp('Cumulative output gap (sacrifice ratio):');
sacRat = -cumsum(100*(s.Y-1))/4;

figure();
plot(sacRat);
grid('on');
title('Sacrifice ratio');
legend('\xi_p=60','\xi_p=80','\xi_p=100','\xi_p=120', ...
   '\xi_p=140','\xi_p=160','\xi_p=180','\xi_p=200', ...
   'location','northWest');
sacRat{startDate:endDate}
```

```
m =
        nonlinear model object: [8] parameterisation(s)
        number of equations: [4 15 4 0 0]
        solution(s) available: [8] parameterisation(s)
        comment: 'Simple Sticky Price Business Cycle Model'
        user data: empty
        export files: [0]

Cumulative output gap (sacrifice ratio):
ans =
        tseries object: 40-by-8
        2009Q2:   0.01803    0.018324    0.018789    0.019322    0.019881    0.020447    0.021011    0.021567
        2009Q3:  0.047905    0.048914    0.050341    0.051927    0.053567    0.055215    0.056847    0.058453
        2009Q4:  0.084259     0.08645    0.089312    0.092417    0.095592    0.098761     0.10189     0.10496
        2010Q1:   0.12273     0.12656     0.13127     0.13628     0.14135     0.14639     0.15135      0.1562
        2010Q2:   0.16004      0.1659     0.17278     0.17998     0.18721     0.19437     0.20139     0.20825
        2010Q3:   0.19395     0.20213     0.21139     0.22095     0.23051     0.23992     0.24915     0.25815
```

```
      2010Q4:   0.22316     0.23381     0.24555     0.25755     0.26947      0.2812     0.29267     0.30386
      2011Q1:   0.24711     0.26028     0.27448     0.28887     0.30313     0.31712      0.3308     0.34414
      2011Q2:   0.26586     0.28144     0.29798     0.31465     0.33112     0.34726     0.36303     0.37842
      2011Q3:   0.27984     0.29764     0.31632     0.33506     0.35356     0.37167     0.38938     0.40665
      2011Q4:   0.28974     0.30948     0.33004     0.35061     0.37089     0.39076     0.41019     0.42916
      2012Q1:   0.29633     0.31769     0.33983     0.36195     0.38377     0.40515     0.42607     0.44651
      2012Q2:   0.30036     0.32301     0.34643     0.36983     0.39291     0.41555     0.43772     0.45941
      2012Q3:   0.30253     0.32616     0.35057     0.37497     0.39905     0.42271     0.44589     0.46861
      2012Q4:   0.30342     0.32776     0.35289     0.37804     0.40289     0.42733     0.45131     0.47483
      2013Q1:   0.30351     0.32831     0.35394     0.37961     0.40502     0.43004     0.45462     0.47876
      2013Q2:   0.30313      0.3282     0.35415     0.38017     0.40595     0.43138     0.45639     0.48097
      2013Q3:   0.30253     0.32774     0.35385     0.38008     0.40609     0.43178     0.45707     0.48196
      2013Q4:   0.30187     0.32712     0.35329     0.37961     0.40575     0.43158     0.45704     0.48212
      2014Q1:   0.30125     0.32646     0.35263     0.37897     0.40515     0.43104     0.45658     0.48176
      2014Q2:   0.30072     0.32586     0.35198     0.37828     0.40444     0.43033     0.45589     0.48111
      2014Q3:   0.30029     0.32535     0.35139     0.37762     0.40373     0.42958     0.45512     0.48032
      2014Q4:   0.29997     0.32494     0.35089     0.37704     0.40308     0.42887     0.45435     0.47951
      2015Q1:   0.29974     0.32462      0.3505     0.37657     0.40252     0.42824     0.45365     0.47874
      2015Q2:   0.29958      0.3244      0.3502     0.37619     0.40207      0.4277     0.45304     0.47807
      2015Q3:   0.29949     0.32425     0.34998      0.3759     0.40171     0.42727     0.45254     0.47749
      2015Q4:   0.29945     0.32416     0.34984      0.3757     0.40144     0.42694     0.45214     0.47703
      2016Q1:   0.29944     0.32411     0.34975     0.37556     0.40126      0.4267     0.45184     0.47667
      2016Q2:   0.29945      0.3241      0.3497     0.37548     0.40113     0.42653     0.45162      0.4764
      2016Q3:   0.29947      0.3241     0.34969     0.37544     0.40106     0.42642     0.45148     0.47621
      2016Q4:    0.2995     0.32412     0.34969     0.37543     0.40102     0.42636     0.45138     0.47608
      2017Q1:   0.29953     0.32415     0.34971     0.37543     0.40102     0.42633     0.45134     0.47601
      2017Q2:   0.29956     0.32418     0.34974     0.37545     0.40103     0.42633     0.45132     0.47597
      2017Q3:   0.29959     0.32421     0.34977     0.37548     0.40105     0.42635     0.45132     0.47597
      2017Q4:   0.29961     0.32423     0.34979     0.37551     0.40108     0.42637     0.45134     0.47598
      2018Q1:   0.29963     0.32426     0.34982     0.37554     0.40111      0.4264     0.45137       0.476
      2018Q2:   0.29964     0.32428     0.34984     0.37556     0.40114     0.42643      0.4514     0.47604
      2018Q3:   0.29965     0.32429     0.34986     0.37559     0.40116     0.42646     0.45144     0.47607
      2018Q4:   0.29966      0.3243     0.34988     0.37561     0.40119     0.42649     0.45147      0.4761
      2019Q1:   0.29967     0.32431     0.34989     0.37562     0.40121     0.42651     0.45149     0.47613
Columns 1 through 6
  'Output'    'Output'    'Output'    'Output'    'Output'    'Output'
Columns 7 through 8
  'Output'    'Output'
      user data: empty
      export files: [0]
```


Disinflation with More Flexible Prices
Inflation, Q/Q PA [Pp Dev]
0
-0.5
-1
2008:1 2009:1 2010:1 2011:1 2012:1 2013:1 2014:1
Policy rate, PA [Pp Dev]
0
-0.5
-1
2008:1 2009:1 2010:1 2011:1 2012:1 2013:1 2014:1
Output [Pct Level Dev]
0
-0.05
-0.1
-0.15
-0.2
2008:1 2009:1 2010:1 2011:1 2012:1 2013:1 2014:1
Hours Worked [Pct Level Dev]
0
-0.05
-0.1
-0.15
-0.2
2008:1 2009:1 2010:1 2011:1 2012:1 2013:1 2014:1
Real Wage [Pct Level Dev]
0
-0.1
-0.2
2008:1 2009:1 2010:1 2011:1 2012:1 2013:1 2014:1
Capital Price [Pct Level Dev]
0
-1
-2
-3
-4
2008:1 2009:1 2010:1 2011:1 2012:1 2013:1 2014:1



8 Help on IRIS Functions Used in This File

Use either `help` to display help in the command window, or `idoc` to display help in an HTML browser window.

```
help model/subsasgn
help model/solve
help model/sstate
help model/sstatedb
help model/simulate
help dbase/dbplot
help dbase/dboverlay
```