

(\* step one is to define the functions: (i) the variables we have are {ka0,ka,al,z,wbar,d1} (ii) {cbar,what} satisfy the condition that {V'[cbar]==0,R[what-cbar]== what} (iii) we want the condtion that {what<wbar}

```
In[ ]:= Quit[]
```

```
In[ ]:= Rfunction = {al Sqrt[w + z] - al Sqrt[z], al Sqrt[wbar + z] - al Sqrt[z] + (w - wbar) / d1};
```

```
V[c_] := ka0 Sqrt[c]
```

```
Vm[c_] := ka Sqrt[c]
```

```
R[w_] := Piecewise[{ {al Sqrt[w + z] - al Sqrt[z], w ≤ wbar},  
  {al Sqrt[wbar + z] - al Sqrt[z] + (w - wbar) / d1, w > wbar} }]
```

```
cbar =
```

$$\frac{ka0^2}{4};$$

$$what = \frac{1}{2} \left( al^2 - \sqrt{al^2 (-ka0^2 + (al - 2\sqrt{z})^2)} - 2 al \sqrt{z} \right);$$

$$wbar = \frac{al^2 d1^2}{4} - z;$$

```
Rcons[w_] := al Sqrt[wbar + z] - al Sqrt[z] + (w - wbar) / d1
```

```
In[ ]:= w /. Solve[w - c == wbar /. Solve[Rcons[w - c] == w, c][[1]], w][[1]]
```

$$Out[ ]:= \frac{1}{2} \left( al \sqrt{al^2 d1^2} - 2 al \sqrt{z} \right)$$

```
In[ ]:= wthreshold = \frac{1}{2} \left( al \sqrt{al^2 d1^2} - 2 al \sqrt{z} \right);
```

```
d1 = 8 / 10; al = 30 / 10; z = 1; ka0 = 1 / 2; ka = 52 / 100;
```

```
In[ ]:= N[{what, cbar}]
```

```
Out[ ]:= {0.200962, 0.0625}
```

```
In[ ]:= FullSimplify[Solve[Flatten[  
  {Simplify[{V'[cbar] == 1, FullSimplify[R[what - cbar] == what, what - cbar < wbar]}],  
  Simplify[D[Rfunction[[1]], w] == D[Rfunction[[2]], w] /. w -> wbar}],  
  {cbar, what, wbar}][[1]]]
```

... **Part:** Part specification Rfunction[[1]] is longer than depth of object.

... **Part:** Part specification Rfunction[[2]] is longer than depth of object.

... **Solve:** This system cannot be solved with the methods available to Solve.

```
Out[ ]:= {V'[cbar] == 1, what == R[-cbar + what], True}
```

$$\text{In}[*]:= \text{cbar} = \frac{\text{ka} \theta^2}{4};$$

$$\text{what} = \frac{1}{2} \left( \text{al}^2 - \sqrt{\text{al}^2 \left( -\text{ka} \theta^2 + \left( \text{al} - 2 \sqrt{z} \right)^2 \right)} - 2 \text{al} \sqrt{z} \right);$$

$$\text{wbar} = \frac{\text{al}^2 \text{dl}^2}{4} - z;$$

(\* step two: find the right variables:  
ignore for this set of variables.

(\* step three: code for the market:

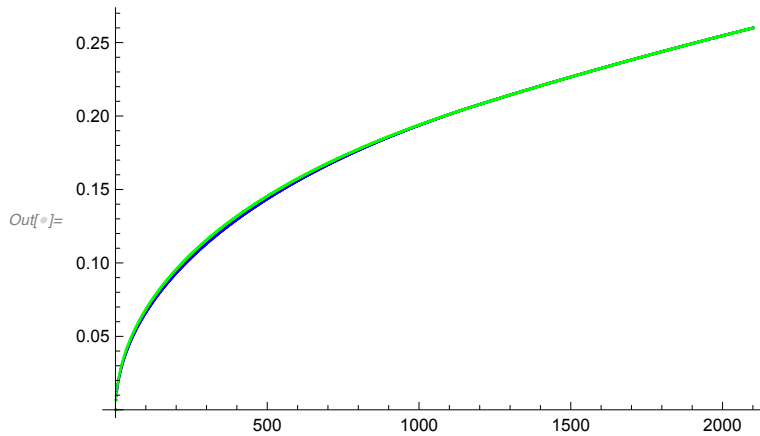
```
In[*]:= wupper0 = wthreshold; wupper = R[R[wthreshold]]; grid = 1/2000;
wealth = Table[w, {w, 0, wupper + grid, grid}];
stationc = Flatten[ParallelTable[
  c /. Solve[R[wealth[[i]] - c] == wealth[[i]], c], {i, 1, Length[wealth]}]];

In[*]:= Pm0 = ParallelTable[Vm[N[stationc[[i]]], {i, 1, Length[wealth]}];
Pm = ParallelTable[Vm[N[stationc[[i]]], {i, 1, Length[wealth]}];

(* i can try to improve this code. in particular,
how to get the continuation payoff.)

In[*]:= Pmplus = Flatten[{ParallelTable[N[Max[
  Table[{1 - dl, dl}.{Vm[wealth[[i]]], {(wealth[[IntegerPart[N[R[wealth[[j]] -
    wealth[[i]]]]/grid] + 2]] - N[R[wealth[[j]] - wealth[[i]]]) /
    (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
    wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
    (N[R[wealth[[j]] - wealth[[i]]] - wealth[[IntegerPart[
      N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]) /
    (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
    wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]])}.
  {Pm[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
    Pm[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]]}],
  {i, 1, j}]], {j, 1, wupper0/grid + 1}],
Pm[[Length[Table[j, {j, 1, wupper0/grid + 1}]] + 1
;;
Length[wealth]]]]];
```

```
In[ ]:= ListPlot[{Pm0, Pm, Pmplus}, PlotStyle -> {Red, Blue, Green}]
```



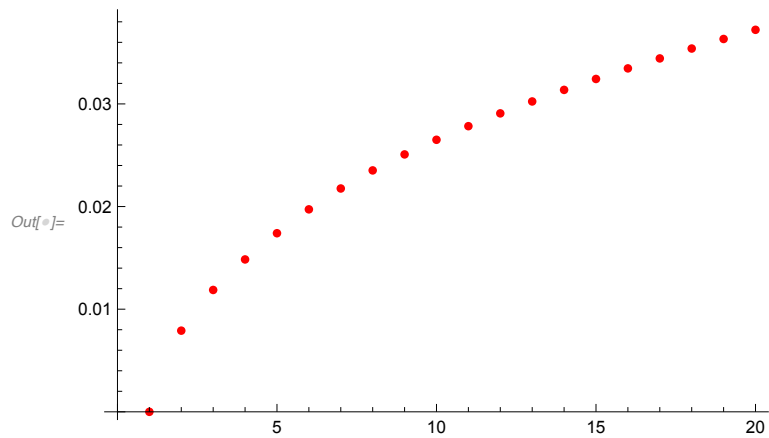
```
In[ ]:= n = 1;
While[n < 25, Pm = Pmplus;
  Pmplus = Flatten[{ParallelTable[N[Max[
    Table[{1 - dl, dl}.{Vm[wealth[[i]]], {(wealth[[IntegerPart[N[R[wealth[[j]]] -
      wealth[[i]]]]/grid] + 2]] - N[R[wealth[[j]]] - wealth[[i]]]])/
    (wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 2]] -
      wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 1]]),
    (N[R[wealth[[j]]] - wealth[[i]]] - wealth[[IntegerPart[
      N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 1]])/
    (wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 2]] -
      wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 1]]).
    {Pm[[IntegerPart[N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 1]],
    Pm[[IntegerPart[N[R[wealth[[j]]] - wealth[[i]]]]/grid] + 2]]}],
    {i, 1, j}]], {j, 1, wupper0/grid + 1}], Pm[[
  Length[Table[j, {j, 1, wupper0/grid + 1}]] + 1 ;; Length[wealth]]]];
  n++]
```

```
In[ ]:= Beep[]
```

```
In[ ]:= {Max[Pmplus - Pm], Min[Pmplus - Pm], Max[Pmplus - Pm0]}
```

```
Out[ ]:= {5.96137 × 10-6, -2.86404 × 10-12, 0.0104276}
```

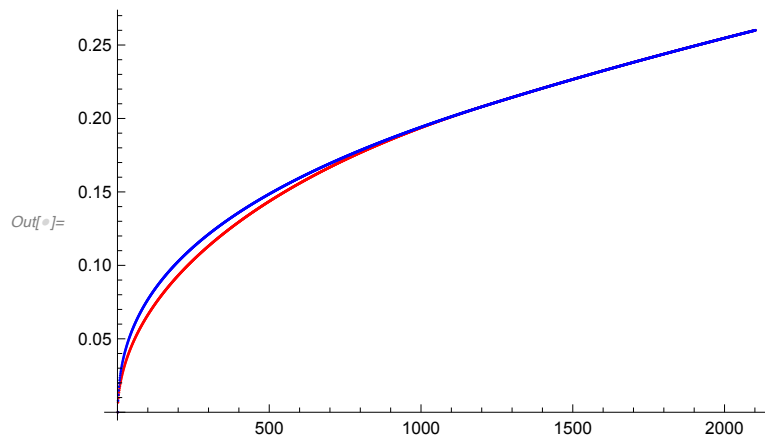
```
In[ ]:= ListPlot[{Pmplus[[1 ;; 20]]}, PlotStyle -> {Red, Blue}]
```



```
In[ ]:= (* the first two shall be close to zero, the last one shall be above zero.)
```



```
In[ ]:= ListPlot[{Pm0, Pmplus}, PlotStyle -> {Red, Blue}, PlotRange -> All]
```



```
(* find the position of updated wealth!
```

```

In[*]:= ParallelTable[Position[Table[{1 - dl, dl}.{Vm[wealth[[i]]],
{ (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
N[R[wealth[[j]] - wealth[[i]]]]) /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
(N[R[wealth[[j]] - wealth[[i]]]] - wealth[[
IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]) /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])}.
{Pm[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
Pm[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]]}],
{i, 1, j}], Max[Table[{1 - dl, dl}.{Vm[wealth[[i]]],
{ (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
N[R[wealth[[j]] - wealth[[i]]]]) /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
(N[R[wealth[[j]] - wealth[[i]]]] - wealth[[
IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]) /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])}.
{Pm[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
Pm[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]]}],
{i, 1, j}]]], {j, 1, wupper0 / grid + 1}]

Out[*]:= {{{{1}}, {{1}}, {{1}}, {{1}}, {{1}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}},
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[illegible]

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In[ ]:= consumecity = Flatten[%]

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```

```
ln[ ]:= wealhtmcrcity =
```

```
Table[IntegerPart[N[R[wealth[[j]] - wealth[[consumecity[[j]]]]]]/grid] + 1,
{j, 1, wupper0/grid + 1}]
```

```
ln[ ]:= wealhtmcrcity132 = {1, 2, 3, 5, 6, 6, 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, 23, 24, 26,
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1192, 1193, 1193, 1194, 1195, 1195, 1197, 1198, 1198, 1199, 1201, 1201};

```

```
ln[ ]:= wealthseq = Table[i, {i, 1, 150}];
```

```
ln[ ]:= wealthseq[[1]] = 7;
```

$$\ln[\bullet] := \mathbf{n} = 2;$$

```
ln[•]:= While[n < 151, wealthseq[[n]] = wealthtmrcity[[wealthseq[[n - 1]]]]; n++]
```

$$ln[\bullet] := \text{wealthseq}$$
[illegible]

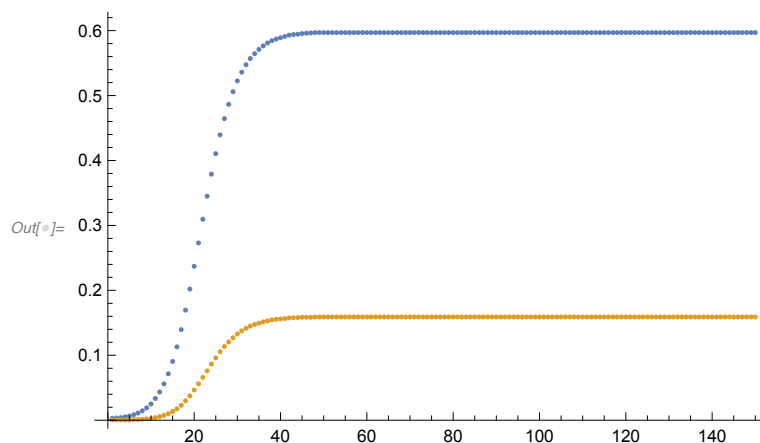
```
ln[•]:= wealthseqvalue = Table[wealth[[wealthseq[[j]]]], {j, 1, 150}]
```

[illegible]

```
In[•]:= consumeseqvalue = Table[wealth[[consumecity[[wealthseq[[j]]]]]], {j, 1, 150}]
```

[illegible]

```
In[6]:= ListPlot[{wealthseqvalue[[1 ;; 150]], consumeseqvalue[[1 ;; 150]]}]
```


$$In[\bullet] := \text{Pmp lus}$$

```
ln[8]:= Pmplus = {0.`, 0.007908500202567217`, 0.011873743822232698`,  
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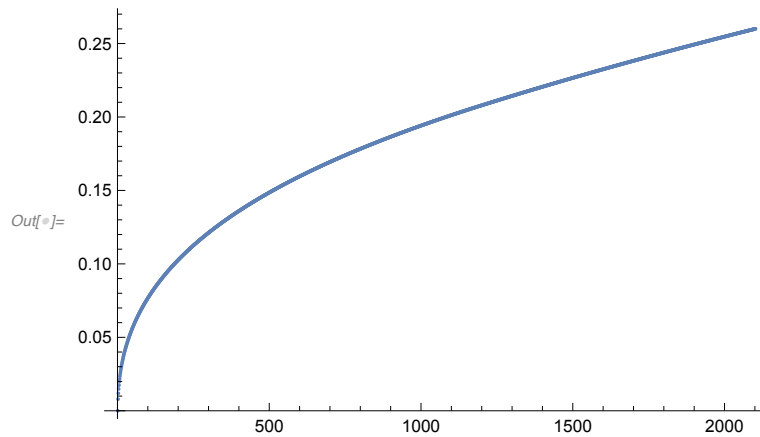
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 0.25304292126040595`, 0.2530963452916695`, 0.2531497580484722`,  
 0.2532031595379489`, 0.25325654976722717`, 0.2533099287434269`,  
 0.2533632964736605`, 0.2534166529650331`, 0.25346999822464195`,  
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 0.25368326708712974`, 0.25373655629412173`, 0.25378983431177854`,  
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 0.2540028346298521`, 0.25405605680636706`, 0.2541092678357088`,  
 0.2541624677248787`, 0.2542156564808706`, 0.25426883411067114`,  
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 0.2546407665712621`, 0.25469385544217593`, 0.2547469332494505`, 0.2548`,

```

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0.2553300609015711`, 0.25538300648242046`, 0.25543594108895484`,
0.25548886472799553`, 0.2555417774063568`, 0.25559467913084577`,
0.2556475699082626`, 0.25570044974540035`, 0.2557533186490451`,
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0.25612309540531486`, 0.2561758770844749`, 0.25622864789090233`,
0.2562814078313134`, 0.25633415691241773`, 0.25638689514091784`,
0.25643962252350944`, 0.2564923390668813`, 0.25654504477771545`,
0.2565977396626868`, 0.2566504237284638`, 0.2567030969817077`,
0.25675575942907297`, 0.25680841107720753`, 0.25686105193275216`,
0.25691368200234105`, 0.2569663012926014`, 0.25701890981015385`,
0.2570715075616121`, 0.2571240945535832`, 0.2571766707926674`,
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0.25754440393842765`, 0.2575968943912174`, 0.25764937415021993`,
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0.2581735850159733`, 0.25822594757305084`, 0.258278299514303`,
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0.25958366666645266`, 0.2596357448426545`, 0.2596878125750225`,
0.25973986986983727`, 0.2597919167333734`, 0.25984395317189896`,
0.25989597919167584`, 0.25994799479895975`, 0.26`, 0.26005199480103974`};

```

```
In[ ]:= ListPlot[Pmplus]
```



## (\* step four: code for the community:

```

In[ ]:= wupper0 = R[what]; wupper = R[R[what]]; grid = 1/2000;
wealth = Table[w, {w, 0, wupper + grid, grid}];
stationc = Flatten[ParallelTable[
    c /. Solve[R[wealth[[i]] - c] == wealth[[i]], c], {i, 1, Length[wealth]}]];
Pmplus = Pmplus[[1 ;; Length[wealth]]];

In[ ]:= Ps0 = ParallelTable[N[Max[V[cbar], Pmplus[[i]]]], {i, 1, Length[Pmplus]}];
Ps = ParallelTable[N[Max[V[cbar], Pmplus[[i]]]], {i, 1, Length[Pmplus]}];

```

```

In[ ]:= Timing[
  Psplus = Flatten[{ParallelTable[N[Max[Table[{1 - dl, dl}.{V[wealth[[i]] + b] - b /.
    If[wealth[[i]] < cbar, b → Min[cbar - wealth[[i]], dl / (1 - dl)
      ({(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] +
        2]] - N[R[wealth[[j]] - wealth[[i]]]]) / (wealth[[
          IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
        wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
          grid] + 1]]), (N[R[wealth[[j]] - wealth[[i]]]] -
        wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
          grid] + 1]])) / (wealth[[IntegerPart[N[R[wealth[[j]] -
            wealth[[i]]]] / grid] + 2]] - wealth[[IntegerPart[
              N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])]}.
      {Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
        Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]]] -
      {(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
        grid] + 2]] - N[R[wealth[[j]] - wealth[[i]]]]) /
        (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
          grid] + 2]] - wealth[[IntegerPart[
            N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
        (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
          N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
        (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
          grid] + 2]] - wealth[[IntegerPart[
            N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])]}.
      {Pmplus[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
        grid] + 1]], Pmplus[[IntegerPart[N[R[wealth[[j]] -
          wealth[[i]]]] / grid] + 2]]] + cbar / 32], b → 0],
    {(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] +
      2]] - N[R[wealth[[j]] - wealth[[i]]]]) /
      (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
        wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
      (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
      (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
        wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])]}.
    {Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
      Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]]]},
    {i, 1, j}]]], {j, 1, wupper0 / grid}], Pmplus[[
  Length[Table[j, {j, 1, wupper0 / grid}]] +
  1 ;; Length[
    wealth]]]]];]

```

```
Out[8]= {17.0035, Null}
```

```
In[8]:= Timing[
  n = 1;
  While[n < 40,
    Ps = ParallelTable[Max[Pstus[[i]], Pmplus[[i]], {i, 1, Length[Pmplus]}];
    Pstus = Flatten[{ParallelTable[
      N[Max[Table[{1 - dl, dl}.{V[wealth[[i]] + b] - b /. If[wealth[[i]] < cbar,
        b → Min[cbar - wealth[[i]], dl / (1 - dl) ({(wealth[[
          IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
          N[R[wealth[[j]] - wealth[[i]]]] / (wealth[[IntegerPart[
            N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] - wealth[[
            IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
          (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
            N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
          (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
            grid] + 2]] - wealth[[IntegerPart[
              N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.{Ps[[
            IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
          Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]]} -
          {(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
            grid] + 2]] - N[R[wealth[[j]] - wealth[[i]]]] /
          (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
            grid] + 2]] - wealth[[IntegerPart[
              N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])),
          (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
            N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
          (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
            grid] + 2]] - wealth[[IntegerPart[
              N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
          {Pmplus[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
            grid] + 1]], Pmplus[[IntegerPart[N[R[wealth[[j]] -
              wealth[[i]]]] / grid] + 2]]} + cbar / 32], b → 0],
      {(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] +
        2]] - N[R[wealth[[j]] - wealth[[i]]]] /
        (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
          wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])),
      (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
        (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
          wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
      {Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
```



```

      Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]]],
      {i, 1, j}]]], {j, 1, wupper0/grid}], Pmplus[[
Length[Table[j, {j, 1, wupper0/grid}]] +
1 ;; Length[
wealth]]]]];
n++]

```

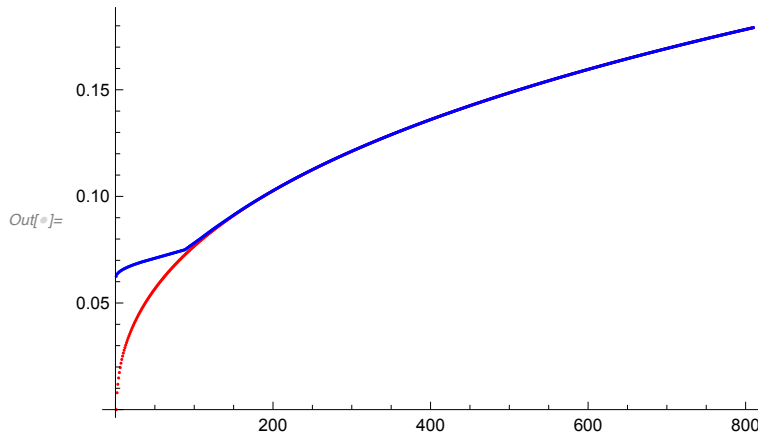
```
Out[8]= {432.288, Null}
```

```
In[9]:= Psplus = Table[Max[Psplus[[i]], Pmplus[[i]]], {i, 1, Length[Pmplus]}];
```

```
In[9]:= Ps = Psplus;
```

```
(* we want to define a point call selection: this is our wstar
```

```
In[9]:= ListPlot[{Pmplus, Psplus}, PlotStyle -> {Red, Blue}]
```



```

In[9]:= {Max[Position[Table[Psplus[[i]] > Pmplus[[i]], {i, 1, Length[Pmplus]}], True]],
Length[Position[Table[Psplus[[i]] > Pmplus[[i]], {i, 1, Length[Pmplus]}], True]]}
wsel = Max[Position[Table[Psplus[[i]] > Pmplus[[i]], {i, 1, Length[Pmplus]}], True]]
{Max[Ps[[1 ;; wsel]] - Psplus[[1 ;; wsel]]], Min[Ps[[1 ;; wsel]] - Psplus[[1 ;; wsel]]]}

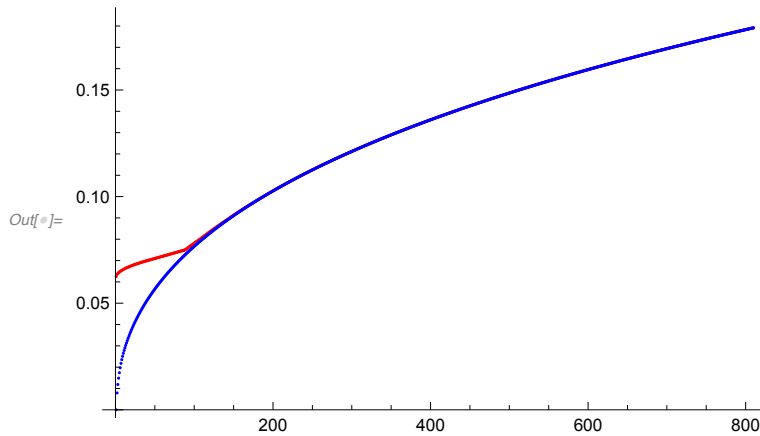
```

```
Out[9]= {187, 187}
```

```
Out[9]= 187
```

```
Out[9]= {0., 0.}
```

```
In[ ]:= ListPlot[{Psplus, Pmplus}, PlotStyle -> {Red, Blue}]
```



```
In[ ]:= Pmplus
```

```
Out[ ]:= {0., 0.0079085, 0.0118737, 0.014847, 0.0174018, 0.0197274, 0.0217597, 0.0235219,
0.0250802, 0.0265058, 0.0278316, 0.029079, 0.0302397, 0.0313668, 0.0324315,
0.0334616, 0.0344332, 0.0353965, 0.036327, 0.0372201, 0.038101, 0.0389514,
0.0397733, 0.0405627, 0.0413349, 0.0420847, 0.0428239, 0.04356, 0.0442752,
0.0449763, 0.0456566, 0.0463198, 0.0469727, 0.0476159, 0.048245, 0.0488681,
0.0494811, 0.0500816, 0.050675, 0.0512592, 0.0518311, 0.0523935, 0.0529456,
0.0534946, 0.0540378, 0.054575, 0.0551043, 0.0556246, 0.0561348, 0.0566391,
0.0571404, 0.0576367, 0.0581284, 0.0586127, 0.0590901, 0.0595633, 0.0600308,
0.0604919, 0.0609483, 0.0614035, 0.0618521, 0.0622974, 0.0627387, 0.0631729,
0.0636019, 0.0640267, 0.0644515, 0.0648737, 0.0652901, 0.0657015, 0.0661089,
0.0665133, 0.0669128, 0.0673118, 0.0677081, 0.0680993, 0.0684874, 0.068873,
0.0692543, 0.0696317, 0.0700089, 0.0703825, 0.0707547, 0.0711222, 0.0714865,
0.0718478, 0.0722068, 0.0725656, 0.0729211, 0.0732738, 0.073623, 0.0739699,
0.0743147, 0.0746577, 0.0749992, 0.075337, 0.0756735, 0.076008, 0.0763388,
0.0766678, 0.0769964, 0.0773227, 0.0776471, 0.0779687, 0.078288, 0.0786049,
0.0789214, 0.0792368, 0.0795497, 0.0798596, 0.0801683, 0.0804755, 0.0807809,
0.0810851, 0.0813873, 0.0816881, 0.0819868, 0.0822836, 0.082579, 0.0828733,
0.0831668, 0.0834578, 0.0837474, 0.0840344, 0.0843207, 0.0846069, 0.0848914,
0.0851736, 0.0854542, 0.0857338, 0.0860118, 0.0862893, 0.0865651, 0.0868395,
0.0871126, 0.087384, 0.0876544, 0.0879239, 0.0881923, 0.0884593, 0.0887248,
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0.0908082, 0.091064, 0.0913182, 0.0915716, 0.0918236, 0.0920744, 0.0923252,
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```

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```

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0.178557, 0.178642, 0.178727, 0.178812, 0.178897, 0.178982, 0.179067, 0.179151}
```

```
ln[8]:= Ps = Psplus;
```

## (\* step five: wealth dynamics

```
ln[9]:= priceupdate = Flatten[
  Table[Position[Table[{1 - dl, dl}.{V[wealth[[i]] + b] - b /. If[wealth[[i]] < cbar,
    b → Min[cbar - wealth[[i]], dl / (1 - dl)
    ({(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
      N[R[wealth[[j]] - wealth[[i]]]] / (wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] - wealth[[
        IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
      (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
      (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
        grid] + 2]] - wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
    {Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
      Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]]} -
    {(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
      N[R[wealth[[j]] - wealth[[i]]]] / (wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] - wealth[[
        IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
      (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
      (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] /
        grid] + 2]] - wealth[[IntegerPart[
        N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.{Pmplus[[
        IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
      Pmplus[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] +
        2]]]} + cbar / 32], b → 0],
    {(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
      N[R[wealth[[j]] - wealth[[i]]]] /
      (wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
        wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
      (N[R[wealth[[j]] - wealth[[i]]]] - wealth[[
```

```

IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]] /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]).
{Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]]},
{i, 1, j}}, Max[Table[{1 - dl, dl}. {V[wealth[[i]] + b] - b / .
If[wealth[[i]] < cbar, b → Min[cbar - wealth[[i]], dl / (1 - dl)
({(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
N[R[wealth[[j]] - wealth[[i]]]] / (wealth[[IntegerPart[
N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] - wealth[[
IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
(N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]] /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/
grid] + 2]] - wealth[[IntegerPart[
N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]).
{Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]]} -
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N[R[wealth[[j]] - wealth[[i]]]] / (wealth[[IntegerPart[
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N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]] /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/
grid] + 2]] - wealth[[IntegerPart[
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IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
Pmplus[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/
grid] + 2]]} + cbar/32], b → 0],
{(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
N[R[wealth[[j]] - wealth[[i]]]] /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
(N[R[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]] /
(wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]]).
{Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
Ps[[IntegerPart[N[R[wealth[[j]] - wealth[[i]]]]/grid] +
2]]}, {i, 1, j}}], {j, 1, wsel}}]

```

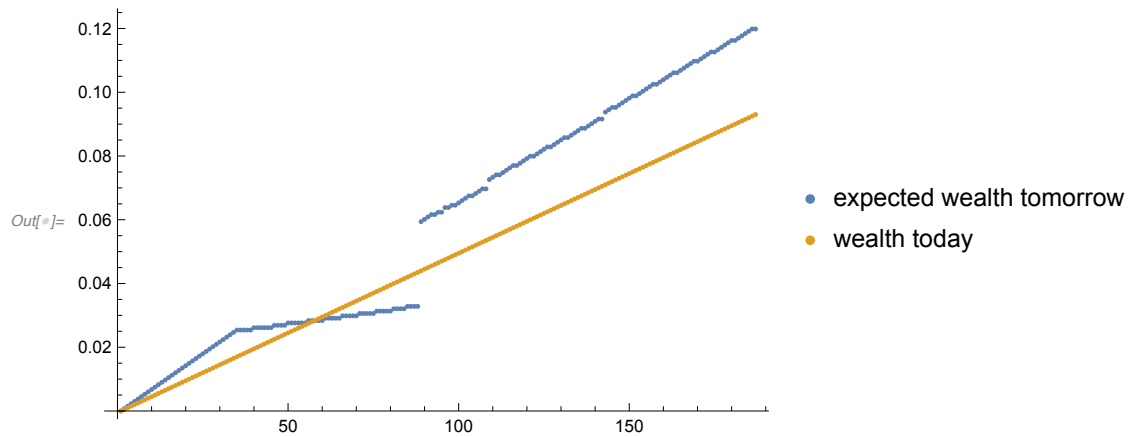


[illegible]

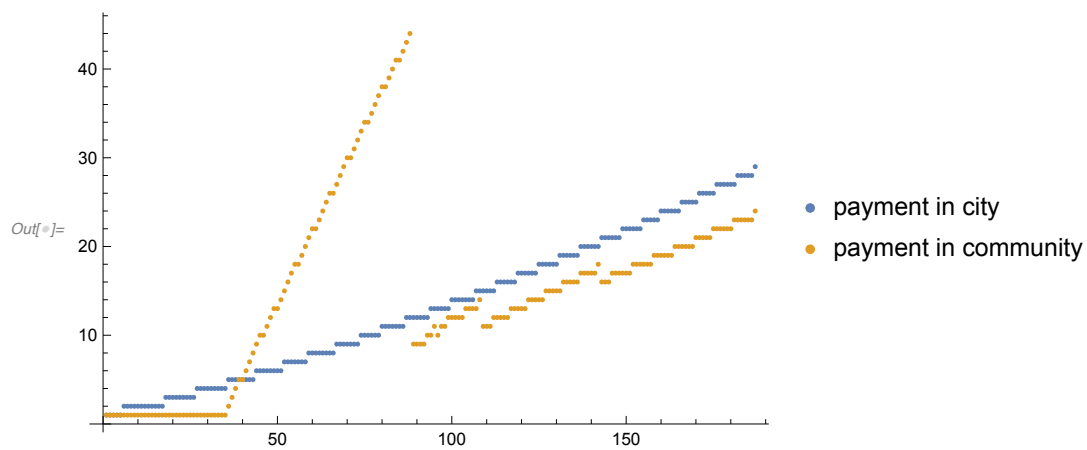
```
ln[j]:= wealthupdate = Table[N[R[wealth[[j]] - wealth[[priceupdate[[j]]]]]], {j, 1, wsel}]
```

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0.0157089, 0.0164549, 0.0172007, 0.0179463, 0.0186918, 0.019437, 0.0201821,
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0.0291088, 0.0291088, 0.0298515, 0.0298515, 0.0298515, 0.0298515, 0.0298515,
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0.0328205, 0.0328205, 0.0328205, 0.0594117, 0.0601471, 0.0608822, 0.0616172,
0.0616172, 0.062352, 0.062352, 0.0638211, 0.0638211, 0.0645554, 0.0645554,
0.0652895, 0.0660235, 0.0667572, 0.0674908, 0.0674908, 0.0682242, 0.0689575,
0.0696905, 0.0696905, 0.072621, 0.0733532, 0.0740852, 0.0740852, 0.0748171,
0.0755487, 0.0762802, 0.0770115, 0.0770115, 0.0777427, 0.0784736, 0.0792044,
0.0799351, 0.0799351, 0.0806655, 0.0813958, 0.0821259, 0.0828558, 0.0828558,
0.0835856, 0.0843152, 0.0850446, 0.0857738, 0.0857738, 0.0865029, 0.0872318,
0.0879605, 0.088689, 0.088689, 0.0894174, 0.0901456, 0.0908737, 0.0916015,
0.0916015, 0.0937841, 0.0945113, 0.0952383, 0.0952383, 0.0959651, 0.0966918,
0.0974183, 0.0981446, 0.0988708, 0.0988708, 0.0995967, 0.100323, 0.101048,
0.101774, 0.102499, 0.102499, 0.103224, 0.103949, 0.104674, 0.105399, 0.106123,
0.106123, 0.106847, 0.107571, 0.108295, 0.109019, 0.109743, 0.109743, 0.110466,
0.111189, 0.111913, 0.112636, 0.112636, 0.113358, 0.114081, 0.114803, 0.115526,
0.116248, 0.116248, 0.11697, 0.117691, 0.118413, 0.119134, 0.119856, 0.119856}
```

```
In[ ]:= ListPlot[{wealthupdate, wealth[[1 ;; wsel]]},
  PlotLegends -> {"expected wealth tomorrow", "wealth today"}]
```



```
In[ ]:= ListPlot[{consumecity[[1 ;; Length[priceupdate]]], priceupdate},
  PlotLegends -> {"payment in city", "payment in community"}]
```



```

In[ ]:= bupdate = Table[b /. If[wealth[[priceupdate[[j]]]] < cbar,
  b → Min[cbar - wealth[[priceupdate[[j]]]], dl / (1 - dl)
    ({(wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] /
      grid] + 2)] - N[R[wealth[[j]] - wealth[[priceupdate[[j]]]]]] /
      (wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[
        j]]]]]] / grid] + 2)] - wealth[[IntegerPart[
          N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]]),
      (N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]] - wealth[[IntegerPart[
        N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]] /
      (wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] /
        grid] + 2)] - wealth[[IntegerPart[
          N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]]}],
      {Ps[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] /
        grid] + 1]], Ps[[IntegerPart[
          N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 2]]] -
      {(wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] /
        grid] + 2)] - N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]} /
      (wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[
        j]]]]]] / grid] + 2)] - wealth[[IntegerPart[
          N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]]),
      (N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]] - wealth[[IntegerPart[
        N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]] /
      (wealth[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] /
        grid] + 2)] - wealth[[IntegerPart[
          N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]]}],
      {Pmplus[[IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] /
        grid] + 1]], Pmplus[[
          IntegerPart[N[R[wealth[[j]]] - wealth[[priceupdate[[j]]]]]] / grid] +
          2]]]) + cbar / 32], b → 0], {j, 1, wsel}]
pupdate = Table[wealth[[priceupdate[[j]]]], {j, 1, wsel}]
cupdate = pupdate + bupdate

```



[illegible]

```
Out[ ]:= {  $\frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16},$   

 $\frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, \frac{1}{16}, 0.0612127,$   

0.0588318, 0.0564915, 0.0569915, 0.0574915, 0.0579915, 0.0584915, 0.056193,  

0.056693, 0.057193, 0.057693, 0.058193, 0.058693, 0.056452, 0.056952, 0.057452,  

0.057952, 0.0557657, 0.0562657, 0.0567657, 0.0572657, 0.0577657, 0.0582657,  

0.0561295, 0.0566295, 0.0571295, 0.0576295, 0.0581295, 0.0560332, 0.0565332,  

0.0570332, 0.0575332, 0.0580332, 0.0559667, 0.0564667, 0.0569667, 0.0574667,  

0.0579667, 0.055945, 0.056445, 0.056945, 0.057445, 0.057945, 0.055965,  

0.056465, 0.056965, 0.057465, 0.057965, 0.0560322, 0.0565322, 0.0570322,  

0.0575322, 0.0556334, 0.0561334, 0.0566334, 0.0571334, 0.00872158, 0.00858124,  

0.00844361, 0.00831989, 0.00881989, 0.00869257, 0.00919257, 0.00844292,  

0.00894292, 0.00882741, 0.00932741, 0.00920656, 0.00909096, 0.00898082,  

0.0088719, 0.0093719, 0.00926271, 0.00915812, 0.00905481, 0.00955481,  

0.00779544, 0.00776488, 0.00772966, 0.00822966, 0.00819214, 0.00815815,  

0.00812932, 0.00809444, 0.00859444, 0.00856181, 0.00852807, 0.00850032,  

0.008469, 0.008969, 0.00893417, 0.00890413, 0.0088773, 0.00884526, 0.00934526,  

0.00931465, 0.00928608, 0.00925842, 0.00922848, 0.00972848, 0.00969897,  

0.00967079, 0.00964473, 0.00961642, 0.0101164, 0.0100872, 0.0100622, 0.0100353,  

0.0100073, 0.0105073, 0.00945313, 0.00945313, 0.00945313, 0.00995313,  

0.00995313, 0.00995313, 0.00995313, 0.00995313, 0.0104531,  

0.0104531, 0.0104531, 0.0104531, 0.0104531, 0.0109531, 0.0109531,  

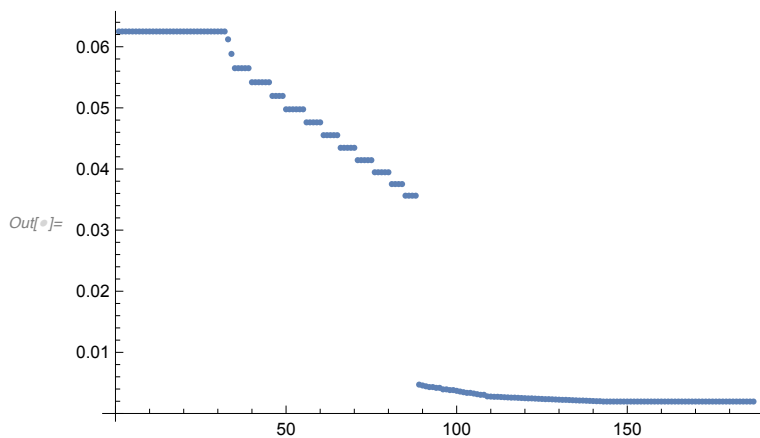
0.0109531, 0.0109531, 0.0109531, 0.0109531, 0.0114531, 0.0114531, 0.0114531,  

0.0114531, 0.0114531, 0.0114531, 0.0119531, 0.0119531, 0.0119531, 0.0119531,  

0.0119531, 0.0124531, 0.0124531, 0.0124531, 0.0124531, 0.0124531, 0.0124531,  

0.0129531, 0.0129531, 0.0129531, 0.0129531, 0.0129531, 0.0129531, 0.0134531 }
```

```
In[ ]:= ListPlot[bupdate]
```

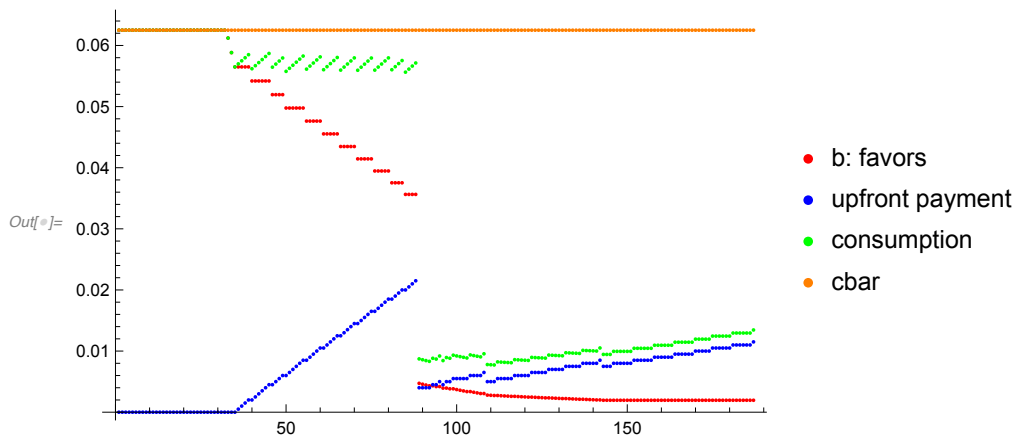


$$In[\bullet] := \text{bupdate}$$
[illegible]

```

In[ ]:= ListPlot[{bupdate, pupdate, cupdate, Table[cbar, {j, 1, wsel}]],
  PlotStyle -> {Red, Blue, Green, Orange},
  PlotLegends -> {"b: favors", "upfront payment", "consumption", "cbar"}]

```



```

In[ ]:= N[Min[cupdate - Table[wealth[[consumecity[[i]]]], {i, 1, Length[cupdate]}]]]

```

```

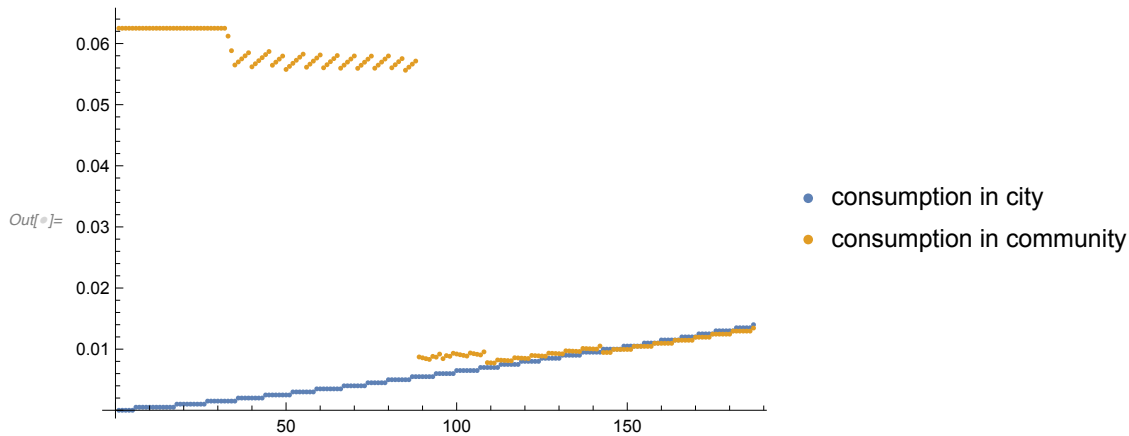
Out[ ]:= -0.000546875

```

```

In[ ]:= ListPlot[{Table[wealth[[consumecity[[i]]]], {i, 1, Length[cupdate]}], cupdate},
  PlotLegends -> {"consumption in city", "consumption in community"}]

```



```

In[ ]:= wtre = Max[Position[Table[wealthupdate[[j]] > wealth[[j]], {j, 1, wsel}], True]]

```

```

Out[ ]:= 187

```

```

In[ ]:= Length[wealthupdate]

```

```

Out[ ]:= 187

```

```

In[ ]:= {N[{wealth[[wtre]], wealthupdate[[wtre]]}]}

```

```

Out[ ]:= {{0.093, 0.119856}}

```

```

+++++
```