

(\* 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} } ]
shocka =
  140 /
  100;
shockb = 60 / 100;
qa = 1 / 2;
qb = 1 - qa;
Ra[w_] := shocka R[w];
Rb[w_] := shockb R[w];
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 =  $\frac{al^2 d1^2}{4} - z$ ;
d1 = 8 / 10;
al = 30 / 10;
z = 1;
ka0 = 1 / 2;
ka = 52 / 100;

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}
```

$$\text{In}[ ]:= \text{cbar} = \frac{\text{ka}0^2}{4};$$

$$\text{what} = \frac{1}{2} \left( \text{al}^2 - \sqrt{\text{al}^2 \left( -\text{ka}0^2 + \left( \text{al} - 2 \sqrt{z} \right)^2 \right) - 2 \text{al} \sqrt{z}} \right);$$

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

(\* step two: find the right variables:

`In[ ]:= ClearAll[dl, al, z, ka0, ka]`

`In[ ]:= {NMaximize[  
 {dl, Simplify[0 < what < wbar && 0 < what - cbar && 0 < dl < 1 && 0 < ka0 < ka && 0 < z &&  
 0 < al && cbar < what - cbar /. {al -> 31/10, z -> 1, ka0 -> 1/2, ka -> 52/100}]],  
 dl], NMinimize[{dl, Simplify[0 < what < wbar && 0 < what - cbar &&  
 0 < dl < 1 && 0 < ka0 < ka && 0 < z && 0 < al && cbar < what - cbar /.  
 {al -> 31/10, z -> 1, ka0 -> 1/2, ka -> 52/100}]], dl]}`

`Out[ ]:= {{1., {dl -> 1.}}, {0.702698, {dl -> 0.702698}}}`

`In[ ]:= dl = 8/10; al = 30/10; z = 1; ka0 = 1/2; ka = 52/100;`

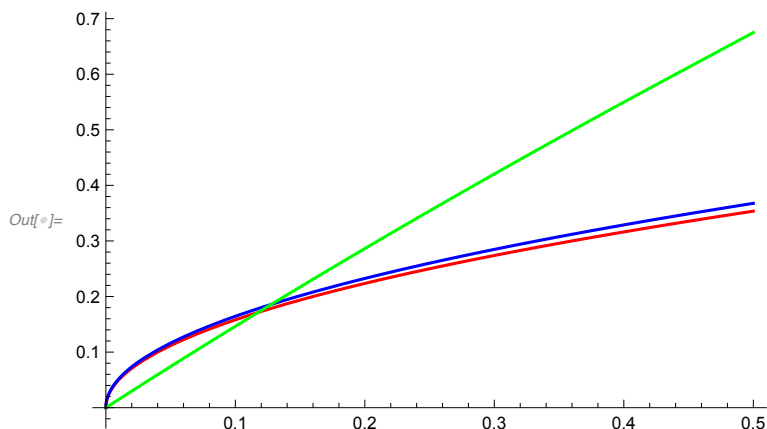
`In[ ]:= FullSimplify[R[w]]`

`Out[ ]:=  $\begin{cases} \frac{1}{20} + \frac{5w}{4} & 25w > 11 \\ 3(-1 + \sqrt{1+w}) & \text{True} \end{cases}$`

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

`Out[ ]:= {0.44, 0.200962, 0.0625}`

`In[ ]:= Plot[{V[w], Vm[w], R[w]}, {w, 0, .5}, PlotRange -> All, PlotStyle -> {Red, Blue, Green}]`



`In[ ]:= N[{R[R[wbar]], R[wbar], R[what], what}]`

`Out[ ]:= {0.8, 0.6, 0.287652, 0.200962}`

## (\* step three: code for the market:

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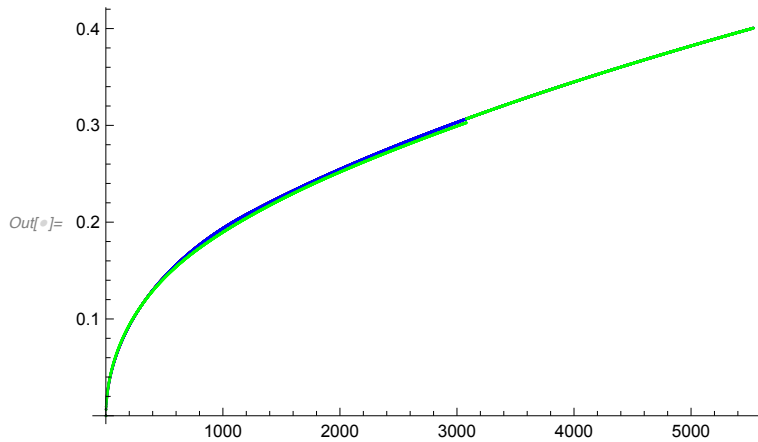
In[ ]:= wupper0 = Ra[Ra[wbar]]; wupper = Ra[Ra[Ra[wbar]]]; grid = 1/2000;
wealth = Table[w, {w, 0, wupper + grid, grid}];
stationc = Flatten[ParallelTable[
  c /. Solve[R[wealth[[i]] - c] == wealth[[i]], c], {i, 1, Length[wealth]}]];

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

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

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```
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]]],
    {qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] +
      2]] - N[Ra[wealth[[j]] - wealth[[i]]]])/(wealth[[IntegerPart[
        N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]] - wealth[[
          IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]]],
      (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[N[Ra[wealth[[
        j]] - wealth[[i]]]]/grid] + 1]])/(wealth[[IntegerPart[
          N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]] - wealth[[
            IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]])]}.
    {Pm[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
      Pm[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]]},
    {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
      N[Rb[wealth[[j]] - wealth[[i]]]])/(wealth[[IntegerPart[
        N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] - wealth[[
          IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]]],
      (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[N[Rb[wealth[[
        j]] - wealth[[i]]]]/grid] + 1]])/(wealth[[IntegerPart[
          N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] - wealth[[
            IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]])]}.
    {Pm[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
      Pm[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]]}],
    {i, 1, j}]]], {j, 1, wupper0/grid}], Pm[
  Length[Table[j, {j, 1, wupper0/grid}]] + 1 ;; Length[wealth]]]]];
  n++]
In[ ]:= Beep[]
```

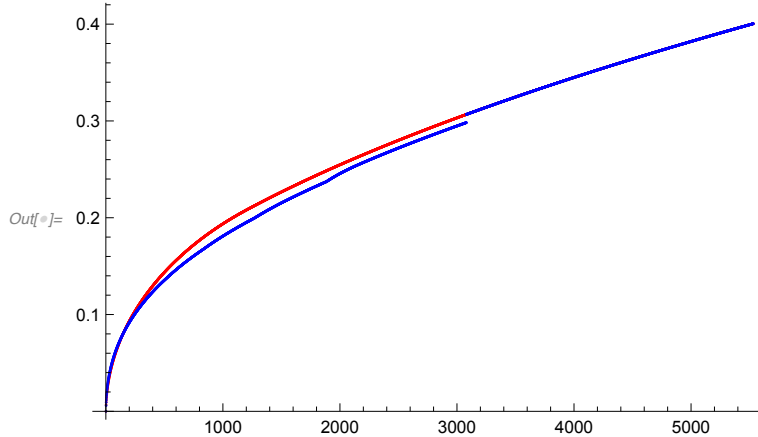
```
In[ ]:= {Max[Pmplus - Pm], Min[Pmplus - Pm], Max[Pmplus - Pm0]}
```

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Out[ ]:= {0., -5.12641 × 10-6, 0.00256789}
```

```
In[ ]:= (* the first two shall be close to zero, the last one shall be above zero.)
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```
In[ ]:= ListPlot[{Pm0, Pmplus}, PlotStyle → {Red, Blue}, PlotRange → All]
```



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(* find the position of updated wealth!
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In[ ]:= ParallelTable[Position[Table[{1 - dl, dl}.{Vm[wealth[[i]]],
  {qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
    N[Ra[wealth[[j]] - wealth[[i]]]] /
    (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
    wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
    (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[
      IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
    (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
    wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
  {Pm[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
    Pm[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
  {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
    N[Rb[wealth[[j]] - wealth[[i]]]] /
    (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
    wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
    (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
      IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
    (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
    wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
  {Pm[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
    Pm[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]}}},
  {i, 1, j}], Max[Table[{1 - dl, dl}.{Vm[wealth[[i]]], {qa, qb}.
    {{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
      N[Ra[wealth[[j]] - wealth[[i]]]] /
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(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
  wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
(N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
  N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]])) /
(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
  wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]]))}.
{Pm[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
  Pm[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]]},
{(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
  N[Rb[wealth[[j]] - wealth[[i]]]]) /
(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
  wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
(N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
  N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]])) /
(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
  wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]]))}.
{Pm[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
  Pm[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]]}},
{i, 1, j}]], {j, 1, wupper0/grid}]

```

Out[8]=

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{{{1}}, {{1}}, {{1}}, {{1}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}}, {{2}},
{{2}}, {{2}}, {{3}}, {{3}}, {{3}}, {{3}}, {{3}}, {{3}}, {{3}}, {{3}}, {{3}}, {{3}},
{{4}}, {{4}}, {{4}}, {{4}}, {{4}}, {{4}}, {{5}}, {{5}}, {{5}}, {{5}}, {{5}},
{{5}}, {{5}}, {{6}}, ... 3006 ..., {{723}}, {{723}}, {{723}}, {{723}}, {{723}},
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large output

[show less](#)[show more](#)[show all](#)[set size limit...](#)

In[9]:= consumecity = Flatten[%]

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In[9]:= consumecity = {1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4,
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 0.39434380938465363`, 0.3943780926978577`, 0.39441237303107013`,  
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0.39979174578772886`, 0.3998255619642146`, 0.39985937528086046`,
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0.3999945999635495`, 0.4000283989918716`, 0.4000621951647019`,
0.400095988482764`, 0.4001297789467812`, 0.4001635665574766`,
0.4001973513155728`, 0.4002311332217922`, 0.400264912276857`,
0.4002986884814888`, 0.4003324618364092`, 0.4003662323423393`,
0.40040000000000003`, 0.4004337648101119`, 0.4004675267733952` }

```

```
ln[ ]:= ListPlot[Pmplus]
```

(\* the value is an upper bound, assuming risk neutral for high wealth.

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

```

ln[ ]:= wupper0 = Ra[what]; wupper = Ra[Ra[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]]];

ln[ ]:= 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[6]:= 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)
      ({qa, qb}. { { (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
        grid] + 2)] - N[Ra[wealth[[j]] - wealth[[i]]]] /
          (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[
            i]]]] / grid] + 2)] - wealth[[IntegerPart[
              N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
        (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
          N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]) /
          (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
            grid] + 2)] - wealth[[IntegerPart[N[Ra[wealth[[j]] -
              wealth[[i]]]] / grid] + 1]])} . {Ps[[IntegerPart[
                N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]], Ps[[
                  IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
        {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
          grid] + 2)] - N[Rb[wealth[[j]] - wealth[[i]]]] /
          (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[
            i]]]] / grid] + 2)] - wealth[[IntegerPart[
              N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
        (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
          N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]) /
          (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
            grid] + 2)] - wealth[[IntegerPart[
              N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])} .
        {Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
          grid] + 1]], Ps[[IntegerPart[
            N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]} - {qa, qb}.
        { { (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
          grid] + 2)] - N[Ra[wealth[[j]] - wealth[[i]]]] /
          (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[
            i]]]] / grid] + 2)] - wealth[[IntegerPart[
              N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
        (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
          N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]) /
          (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
            grid] + 2)] - wealth[[IntegerPart[
              N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])} .
        {Pmplus[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
          grid] + 1]], Pmplus[[IntegerPart[
            N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
        {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
          grid] + 2)] - N[Rb[wealth[[j]] - wealth[[i]]]] /
          (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
            grid] + 2)] - wealth[[IntegerPart[
              N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
        (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
          N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]) /
          (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
            grid] + 2)] - wealth[[IntegerPart[
              N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])} }

```

```

      grid] + 2]] - N[Rb[wealth[[j]] - wealth[[i]]]]) /
    (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[
      i]]]] / grid] + 2]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
    (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
    (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
      grid] + 2]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
    {Pmplus[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
      grid] + 1]], Pmplus[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]}}], b → 0 ],
{qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
  grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]]) /
  (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
  grid] + 2]] - wealth[[IntegerPart[
  N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
  (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
  N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
  (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
  grid] + 2]] - wealth[[IntegerPart[
  N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
  {Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
  Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
  {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
  N[Rb[wealth[[j]] - wealth[[i]]]]) /
  (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
  wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] +
  1]]), (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
  IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
  (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
  grid] + 2]] - wealth[[IntegerPart[
  N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
  {Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
  Ps[[IntegerPart[N[Rb[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[4]= {79.8194, Null}

```

In[ ]:= Timing[
  n = 1;
  While[n < 40,
    Ps = ParallelTable[Max[Psplus[[i]], Pmplus[[i]]], {i, 1, Length[Pmplus]};
    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) ({qa, qb}.{{(wealth[[
          IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] +
            2]] - N[Ra[wealth[[j]] - wealth[[i]]]] /
            (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
              grid] + 2]] - wealth[[IntegerPart[
                N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
            (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
              N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]] /
              (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                grid] + 2]] - wealth[[IntegerPart[N[Ra[wealth[[j]] -
                  wealth[[i]]]] / grid] + 1]]).{Ps[[IntegerPart[
                    N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]], Ps[[
                      IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]}],
            {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
              grid] + 2]] - N[Rb[wealth[[j]] - wealth[[i]]]] /
              (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[
                i]]]] / grid] + 2]] - wealth[[IntegerPart[
                  N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
            (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
              N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]] /
              (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
                grid] + 2]] - wealth[[IntegerPart[
                  N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]).{
              Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
                grid] + 1]], Ps[[IntegerPart[
                  N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]} - {qa, qb}.
            {(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
              grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]] /
              (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[
                i]]]] / grid] + 2]] - wealth[[IntegerPart[
                  N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]),
            (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
              N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]] /
              (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                grid] + 2]] - wealth[[IntegerPart[
                  N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]).}
            N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]}].
    ]
  ]

```

```

{Pmplus[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
  grid] + 1]], Pmplus[[IntegerPart[
  N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]],
{ (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
  grid] + 2]] - N[Rb[wealth[[j]] - wealth[[i]]]] /
  (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
    grid] + 2]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])),
  (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
    N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
  (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
    grid] + 2]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
{Pmplus[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
  grid] + 1]], Pmplus[[IntegerPart[
  N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]]}], b → 0 ],
{qa, qb}. { { (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
  grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]] /
  (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
    grid] + 2]] - wealth[[IntegerPart[
      N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])),
  (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
    N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
  (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
    grid] + 2]] - wealth[[IntegerPart[
      N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
{Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
  Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]],
{ (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
  N[Rb[wealth[[j]] - wealth[[i]]]] /
  (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
  wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] +
  1]])), (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
  IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
  (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
    grid] + 2]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
{Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
  Ps[[IntegerPart[N[Rb[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]= {1681.83, Null}

```

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

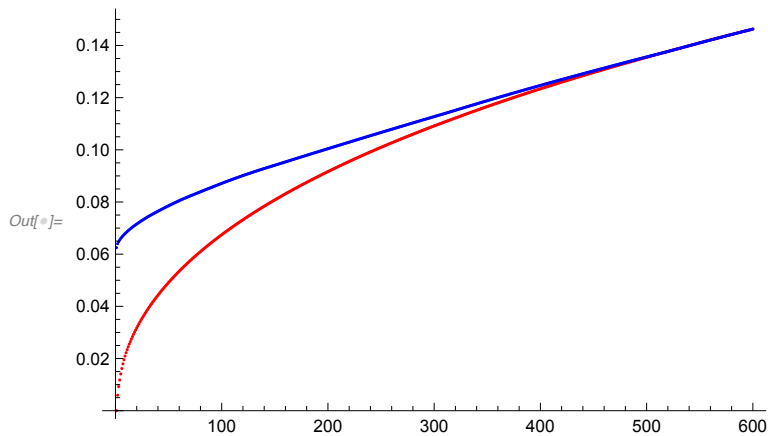
```

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

```

In[9]:= ListPlot[{Pmplus[[1 ;; 600]], Psplus[[1 ;; 600]]}, 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]= {517, 517}

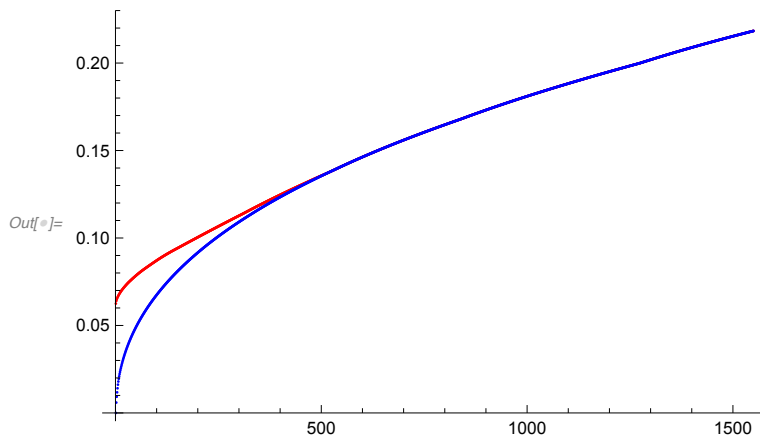
Out[9]= 517

Out[9]= { $2.07692 \times 10^{-6}$ ,  $3.1466 \times 10^{-7}$ }

```

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

```



In[ ]:= **Pmplus**

```
Out[ ]:= {0., 0.00593028, 0.00923446, 0.011774, 0.0140995, 0.0161701, 0.0179558, 0.0195202,
0.0209332, 0.0222177, 0.0234008, 0.0244965, 0.0255307, 0.0265008, 0.0274641,
0.0283843, 0.0292639, 0.0301156, 0.0309367, 0.0317266, 0.0324934, 0.0332359,
0.033975, 0.0346913, 0.035387, 0.0360637, 0.0367219, 0.0373678, 0.0380005,
0.0386236, 0.0392386, 0.0398406, 0.0404296, 0.0410047, 0.0415687, 0.0421234,
0.0426723, 0.0432164, 0.0437518, 0.0442783, 0.0447947, 0.0453027, 0.0458016,
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0.0495962, 0.0500465, 0.0504914, 0.0509293, 0.0513609, 0.0517894, 0.0522142,
0.0526364, 0.0530535, 0.0534659, 0.0538739, 0.0542775, 0.0546765, 0.0550753,
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0.0581276, 0.0584939, 0.058857, 0.0592177, 0.0595766, 0.0599331, 0.0602861,
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 0.173142, 0.173224, 0.173306, 0.173389, 0.173471, 0.173553, 0.173635, 0.173717,  
 0.173798, 0.17388, 0.173962, 0.174043, 0.174125, 0.174206, 0.174288, 0.174369,  
 0.17445, 0.174531, 0.174612, 0.174693, 0.174774, 0.174855, 0.174936, 0.175016,  
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 0.175739, 0.175819, 0.175899, 0.175979, 0.176058, 0.176138, 0.176217, 0.176297,  
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 0.178804, 0.178881, 0.178958, 0.179036, 0.179113, 0.17919, 0.179266, 0.179343,  
 0.17942, 0.179497, 0.179573, 0.17965, 0.179727, 0.179803, 0.179879, 0.179956,  
 0.180032, 0.180108, 0.180184, 0.18026, 0.180337, 0.180412, 0.180488, 0.180564,  
 0.18064, 0.180716, 0.180791, 0.180867, 0.180942, 0.181018, 0.181093, 0.181169,  
 0.181244, 0.181319, 0.181394, 0.181469, 0.181544, 0.181619, 0.181694, 0.181769,  
 0.181844, 0.181919, 0.181993, 0.182068, 0.182142, 0.182217, 0.182291,  
 0.182366, 0.18244, 0.182514, 0.182589, 0.182663, 0.182737, 0.182811, 0.182885,  
 0.182959, 0.183033, 0.183106, 0.18318, 0.183254, 0.183327, 0.183401, 0.183474,  
 0.183548, 0.183621, 0.183695, 0.183768, 0.183841, 0.183914, 0.183987, 0.18406,  
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 0.184715, 0.184788, 0.18486, 0.184933, 0.185005, 0.185077, 0.18515, 0.185222,  
 0.185294, 0.185366, 0.185438, 0.18551, 0.185582, 0.185654, 0.185726, 0.185798,  
 0.18587, 0.185941, 0.186013, 0.186085, 0.186156, 0.186228, 0.186299, 0.186371,  
 0.186442, 0.186514, 0.186585, 0.186656, 0.186728, 0.186799, 0.18687, 0.186941,  
 0.187012, 0.187083, 0.187154, 0.187225, 0.187296, 0.187367, 0.187438, 0.187509,  
 0.187579, 0.18765, 0.187721, 0.187791, 0.187862, 0.187932, 0.188003, 0.188073,  
 0.188144, 0.188214, 0.188284, 0.188355, 0.188425, 0.188495, 0.188565, 0.188635,  
 0.188705, 0.188775, 0.188845, 0.188915, 0.188985, 0.189055, 0.189125, 0.189194,  
 0.189264, 0.189334, 0.189403, 0.189473, 0.189542, 0.189612, 0.189681, 0.189751,  
 0.18982, 0.189889, 0.189959, 0.190028, 0.190097, 0.190166, 0.190236, 0.190305,  
 0.190374, 0.190443, 0.190512, 0.190581, 0.19065, 0.190718, 0.190787, 0.190856,  
 0.190925, 0.190993, 0.191062, 0.191131, 0.191199, 0.191268, 0.191336, 0.191405,  
 0.191473, 0.191541, 0.19161, 0.191678, 0.191746, 0.191815, 0.191883, 0.191951,  
 0.192019, 0.192087, 0.192155, 0.192223, 0.192291, 0.192359, 0.192427, 0.192495,  
 0.192562, 0.19263, 0.192698, 0.192766, 0.192833, 0.192901, 0.192968, 0.193036,

0.193103, 0.193171, 0.193238, 0.193306, 0.193373, 0.19344, 0.193508, 0.193575,  
 0.193642, 0.193709, 0.193776, 0.193843, 0.19391, 0.193977, 0.194044, 0.194111,  
 0.194178, 0.194245, 0.194312, 0.194379, 0.194446, 0.194512, 0.194579, 0.194646,  
 0.194712, 0.194779, 0.194846, 0.194912, 0.194979, 0.195045, 0.195112, 0.195178,  
 0.195245, 0.195311, 0.195378, 0.195444, 0.19551, 0.195576, 0.195643, 0.195709,  
 0.195775, 0.195841, 0.195907, 0.195973, 0.19604, 0.196106, 0.196172, 0.196238,  
 0.196304, 0.196369, 0.196435, 0.196501, 0.196567, 0.196633, 0.196699, 0.196764,  
 0.19683, 0.196896, 0.196961, 0.197027, 0.197093, 0.197158, 0.197224, 0.197289,  
 0.197355, 0.19742, 0.197486, 0.197551, 0.197616, 0.197682, 0.197747, 0.197812,  
 0.197877, 0.197943, 0.198008, 0.198073, 0.198138, 0.198203, 0.198268, 0.198333,  
 0.198398, 0.198463, 0.198528, 0.198593, 0.198658, 0.198723, 0.198788,  
 0.198853, 0.198917, 0.198982, 0.199047, 0.199112, 0.199176, 0.199241,  
 0.199305, 0.19937, 0.199435, 0.199499, 0.199564, 0.199628, 0.199693, 0.199757,  
 0.199821, 0.199886, 0.199956, 0.200031, 0.200106, 0.20018, 0.200255, 0.200329,  
 0.200404, 0.200478, 0.200552, 0.200626, 0.2007, 0.200774, 0.200848, 0.200923,  
 0.200997, 0.201071, 0.201146, 0.20122, 0.201294, 0.201368, 0.201442, 0.201516,  
 0.20159, 0.201664, 0.201737, 0.201811, 0.201884, 0.201958, 0.202031, 0.202104,  
 0.202178, 0.202251, 0.202324, 0.202397, 0.20247, 0.202542, 0.202615, 0.202688,  
 0.20276, 0.202833, 0.202905, 0.202978, 0.20305, 0.203122, 0.203195, 0.203267,  
 0.203339, 0.203411, 0.203483, 0.203554, 0.203626, 0.203698, 0.203769, 0.203841,  
 0.203912, 0.203984, 0.204055, 0.204126, 0.204197, 0.204269, 0.20434, 0.204411,  
 0.204481, 0.204552, 0.204623, 0.204694, 0.204764, 0.204835, 0.204905, 0.204976,  
 0.205046, 0.205116, 0.205187, 0.205257, 0.205327, 0.205397, 0.205467, 0.205537,  
 0.205607, 0.205676, 0.205746, 0.205816, 0.205885, 0.205955, 0.206024,  
 0.206094, 0.206163, 0.206232, 0.206301, 0.206371, 0.20644, 0.206509, 0.206578,  
 0.206646, 0.206715, 0.206784, 0.206853, 0.206921, 0.20699, 0.207058, 0.207127,  
 0.207195, 0.207264, 0.207332, 0.2074, 0.207468, 0.207536, 0.207604, 0.207672,  
 0.20774, 0.207808, 0.207876, 0.207944, 0.208011, 0.208079, 0.208146, 0.208214,  
 0.208281, 0.208349, 0.208416, 0.208483, 0.208551, 0.208618, 0.208685, 0.208752,  
 0.208819, 0.208886, 0.208953, 0.209019, 0.209086, 0.209153, 0.20922, 0.209286,  
 0.209353, 0.209419, 0.209486, 0.209552, 0.209618, 0.209685, 0.209751, 0.209817,  
 0.209883, 0.209949, 0.210015, 0.210081, 0.210147, 0.210213, 0.210278, 0.210344,  
 0.21041, 0.210475, 0.210541, 0.210606, 0.210672, 0.210737, 0.210803, 0.210868,  
 0.210933, 0.210998, 0.211064, 0.211129, 0.211194, 0.211259, 0.211324, 0.211388,  
 0.211453, 0.211518, 0.211583, 0.211647, 0.211712, 0.211777, 0.211841, 0.211906,  
 0.21197, 0.212035, 0.212099, 0.212163, 0.212227, 0.212292, 0.212356, 0.21242,  
 0.212484, 0.212548, 0.212612, 0.212676, 0.212739, 0.212803, 0.212867, 0.212931,  
 0.212994, 0.213058, 0.213121, 0.213185, 0.213248, 0.213312, 0.213375, 0.213439,  
 0.213502, 0.213565, 0.213628, 0.213691, 0.213754, 0.213817, 0.21388, 0.213943,  
 0.214006, 0.214069, 0.214132, 0.214195, 0.214257, 0.21432, 0.214383, 0.214445,  
 0.214508, 0.21457, 0.214633, 0.214695, 0.214757, 0.21482, 0.214882, 0.214944,  
 0.215006, 0.215069, 0.215131, 0.215193, 0.215255, 0.215317, 0.215378, 0.21544,  
 0.215502, 0.215564, 0.215626, 0.215687, 0.215749, 0.215811, 0.215872, 0.215934,  
 0.215995, 0.216057, 0.216118, 0.216179, 0.216241, 0.216302, 0.216363, 0.216424,

```
0.216485, 0.216546, 0.216608, 0.216669, 0.21673, 0.21679, 0.216851, 0.216912,
0.216973, 0.217034, 0.217094, 0.217155, 0.217216, 0.217276, 0.217337, 0.217398,
0.217458, 0.217519, 0.217579, 0.21764, 0.2177, 0.217761, 0.217821, 0.217881,
0.217942, 0.218002, 0.218062, 0.218123, 0.218183, 0.218243, 0.218303, 0.218363}
```

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

**(\* step five: wealth dynamics:**

**find {c,b,p,w} for each point below wsel;**

**(\*\*\*\*\* important, i actually need**

**this for wealth above wsel as well!**

```
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)
    ({qa, qb}.{ (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
      grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]] / (wealth[[
        IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
        wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] +
          1]]), (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[
            IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
        (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
          grid] + 2]] - wealth[[IntegerPart[
            N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])]}.
    {Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
      Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
    { (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] +
      2]] - N[Rb[wealth[[j]] - wealth[[i]]]] / (wealth[[
        IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
        wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] +
          1]]), (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
            IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
        (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
          grid] + 2]] - wealth[[IntegerPart[
            N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])]}.
    {Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
      Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]} } -
    {qa, qb}.{ (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
      grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]] / (wealth[[
        IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
```

```

wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] +
1]]), (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[
IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]])/
(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] +
2]] - wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/
grid] + 1]])).{Pmplus[[IntegerPart[
N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]], Pmplus[[
IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]]],
{(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] +
2]] - N[Rb[wealth[[j]] - wealth[[i]]]])/(wealth[[
IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] +
1]]), (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]])/
(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/
grid] + 2]] - wealth[[IntegerPart[
N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]]))}.
{Pmplus[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/
grid] + 1]], Pmplus[[IntegerPart[
N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]]]}], b → 0],
{qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/
grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]])/
(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
(N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]])/
(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]]))}.
{Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]]/grid] + 2]]],
{(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
N[Rb[wealth[[j]] - wealth[[i]]]])/
(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]]),
(N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[IntegerPart[
N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]])/
(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 2]] -
wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]]))}.
{Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]]/grid] + 1]],
Ps[[IntegerPart[N[Rb[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)
      ({qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                    grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]]) / (wealth[[
                    IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
                    wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                    grid] + 1]]), (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[
                    IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
                    (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                    grid] + 2]] - wealth[[IntegerPart[
                    N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
      {Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
       Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
      {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] +
                2]] - N[Rb[wealth[[j]] - wealth[[i]]]]) / (wealth[[
                IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
                wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
                grid] + 1]]), (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
                IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
                (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
                grid] + 2]] - wealth[[IntegerPart[
                N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.
      {Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]],
       Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]]} -
      {qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                    grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]]) / (wealth[[
                    IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
                    wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                    grid] + 1]]), (N[Ra[wealth[[j]] - wealth[[i]]]] - wealth[[
                    IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
                    (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] /
                    grid] + 2]] - wealth[[IntegerPart[N[Ra[wealth[[j]] -
                    wealth[[i]]]] / grid] + 1]]))}. {Pmplus[[IntegerPart[
                    N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 1]], Pmplus[[
                    IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]]] / grid] + 2]]},
      {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] +
                2]] - N[Rb[wealth[[j]] - wealth[[i]]]]) / (wealth[[
                IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 2]] -
                wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
                grid] + 1]]), (N[Rb[wealth[[j]] - wealth[[i]]]] - wealth[[
                IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]])) /
                (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]]] /
                grid] + 2]] - wealth[[IntegerPart[
                N[Rb[wealth[[j]] - wealth[[i]]]] / grid] + 1]]))}.

```

```

      N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 1]]}.
    {Pmplus[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] /
      grid] + 1]], Pmplus[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 2]]]}], b → 0],
    {qa, qb}.{{(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] /
      grid] + 2]] - N[Ra[wealth[[j]] - wealth[[i]]]) /
      (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 2]] -
      wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 1]]),
      (N[Ra[wealth[[j]] - wealth[[i]]] - wealth[[IntegerPart[
      N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 1]])) /
      (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 2]] -
      wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 1]]))}.
    {Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 1]],
      Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[i]]] / grid] + 2]]},
    {(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] +
      2]] - N[Rb[wealth[[j]] - wealth[[i]]]) /
      (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 2]] -
      wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 1]]),
      (N[Rb[wealth[[j]] - wealth[[i]]] - wealth[[IntegerPart[
      N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 1]])) /
      (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 2]] -
      wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 1]]))}.
    {Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] + 1]],
      Ps[[IntegerPart[N[Rb[wealth[[j]] - wealth[[i]]] / grid] +
      2]]]}], {i, 1, j}]]], {j, 1, wsel}]]

```

[illegible]

```
ln[9]:= wealthupdate = Table[N[R[wealth[[j]] - wealth[[priceupdate[[j]]]]]], {j, 1, wsel}]
```

```
ln[""]:= wealthupdate = {0.0, 0.0007499062734299677, 0.0014996251873831135`,  
0.002249156882219605`, 0.002998501498127304`, 0.003747659175118212`,  
0.004496630053027584`, 0.0052454142715201435`, 0.005994011970083424`,  
0.006742423288033983`, 0.007490648364513408`, 0.008238687338489203`,  
0.008986540348759675`, 0.009734207533947714`, 0.010481689032503905`,  
0.011228984982709633`, 0.011976095522672203`, 0.012723020790327944`,  
0.013469760923443985`, 0.014216316059615597`, 0.014962686336267073`,  
0.01570887189065351`, 0.016454872859860803`, 0.01720068938080388`,  
0.01794632159023024`, 0.01869176962471597`, 0.019437033620671507`,  
0.020182113714336758`, 0.0209270100417851`, 0.02167172273892115`,  
0.022416251941483`, 0.023160597785039982`, 0.023904760404996228`,  
0.02464873993658978`, 0.02539253651488993`, 0.026136150274802095`,  
0.02687958135106472`, 0.027622829878252375`, 0.028365895990773105`,  
0.029108779822870634`, 0.029851481508623046`, 0.03059400118194633`,  
0.03133633897659038`, 0.03207849502614302`, 0.032820469464026836`,  
0.0335622624235028`, 0.03430387403766799`, 0.035045304439457414`,  
0.03578655376164397`, 0.03652762213683802`, 0.03726850969748785`,
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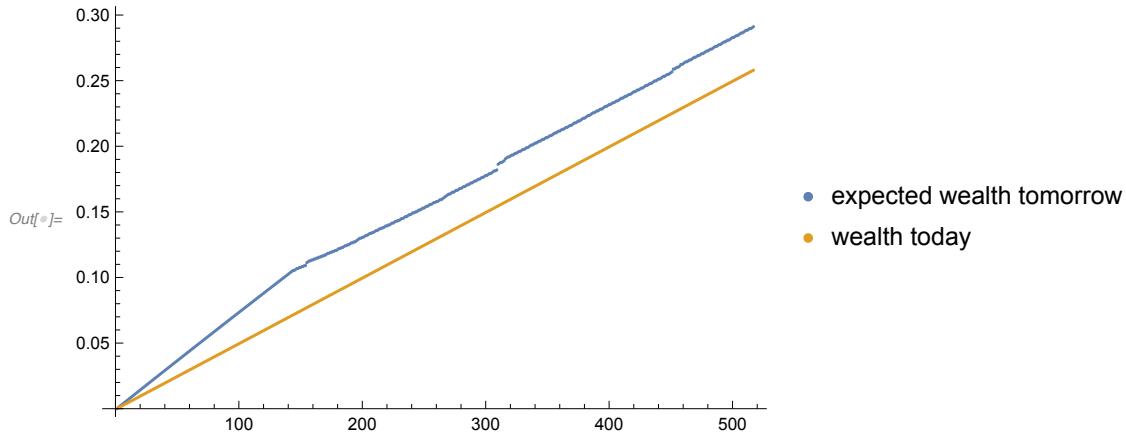
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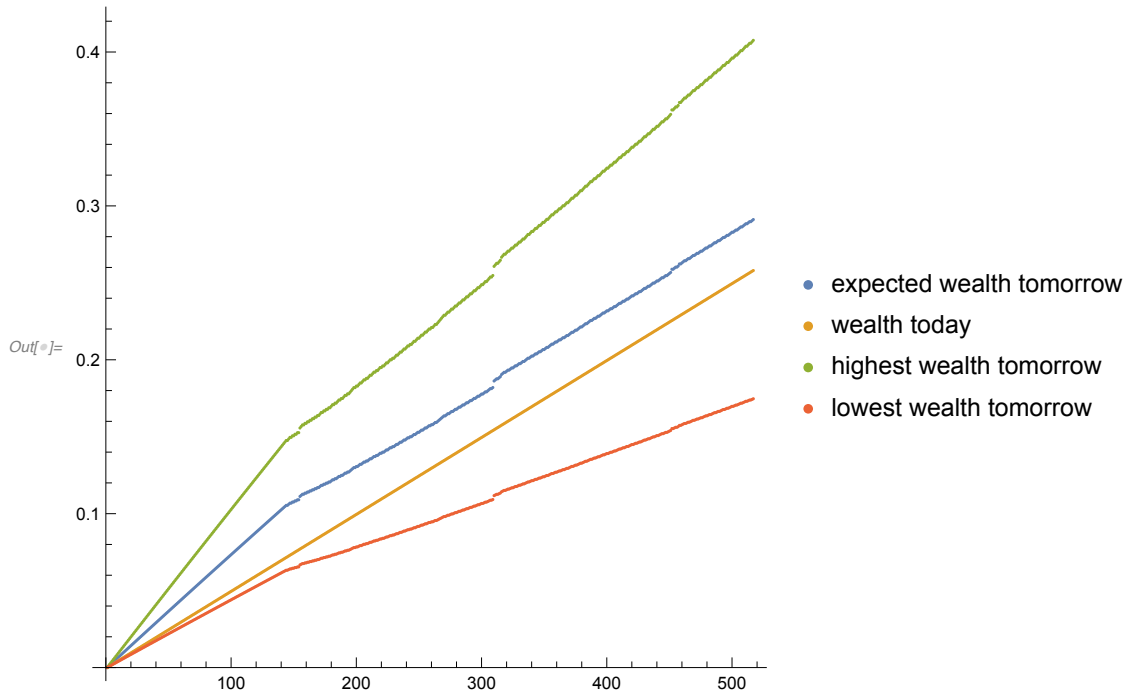
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In[ ]:= ListPlot[{wealthupdate, wealth[[1 ;; Length[wealthupdate]]}],
PlotLegends -> {"expected wealth tomorrow", "wealth today"}
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```

In[ ]:= ListPlot[{wealthupdate, wealth[[1 ;; Length[wealthupdate]]], shocka wealthupdate,
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```

In[ ]:= bupdate = Table[b /.
  If[wealth[[priceupdate[[j]]]] < cbar, b -> Min[cbar - wealth[[priceupdate[[j]]]],
    dl / (1 - dl) ({qa, qb}.{{(wealth[[IntegerPart[
      N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]] / grid] + 2)] -
      N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]]] / (wealth[[
      IntegerPart[N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]] /
      grid] + 2)] - wealth[[IntegerPart[
      N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]]] / grid] + 1)]],
    (N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]] - wealth[[
      IntegerPart[N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]] /

```

```

grid] + 1])) / (wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[
priceupdate[[j]]]]]] / grid] + 2]] - wealth[[IntegerPart[
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{Ps[[IntegerPart[N[Ra[wealth[[j]] - wealth[[priceupdate[[j]]]]]] /
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{(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[priceupdate[[j]]]]]] /
grid] + 2]] - N[Rb[wealth[[j]] - wealth[[priceupdate[[j]]]]]] /
(wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[priceupdate[[
j]]]]]] / grid] + 2]] - wealth[[IntegerPart[
N[Rb[wealth[[j]] - wealth[[priceupdate[[j]]]]]] / grid] + 1]]),
(N[Rb[wealth[[j]] - wealth[[priceupdate[[j]]]]]] - wealth[[
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grid] + 1]])) / (wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[
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(wealth[[IntegerPart[N[Ra[wealth[[j]] - wealth[[priceupdate[[
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wealth[[IntegerPart[N[Rb[wealth[[j]] - wealth[[priceupdate[[
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Pmplus[[IntegerPart[N[Rb[wealth[[j]] - wealth[[priceupdate[[j]]]]]]
grid] + 2]]]]], b → 0 ], {j, 1, wsel}]
pupdate = Table[wealth[[priceupdate[[j]]]], {j, 1, wsel}]
cupdate = pupdate + bupdate
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```

```
In[ ]:= Length[priceupdate]
```

```
Out[ ]:= 517
```

```
In[ ]:= 143 / 517 + 1.5
```

```
Out[ ]:= 1.7766
```

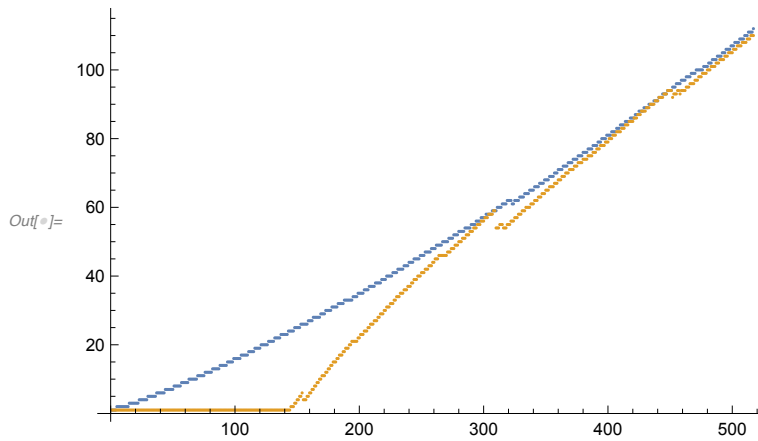
```
In[ ]:= Max[consumecity[[1 ;; 517]] - priceupdate]
```

```
Out[ ]:= 23
```

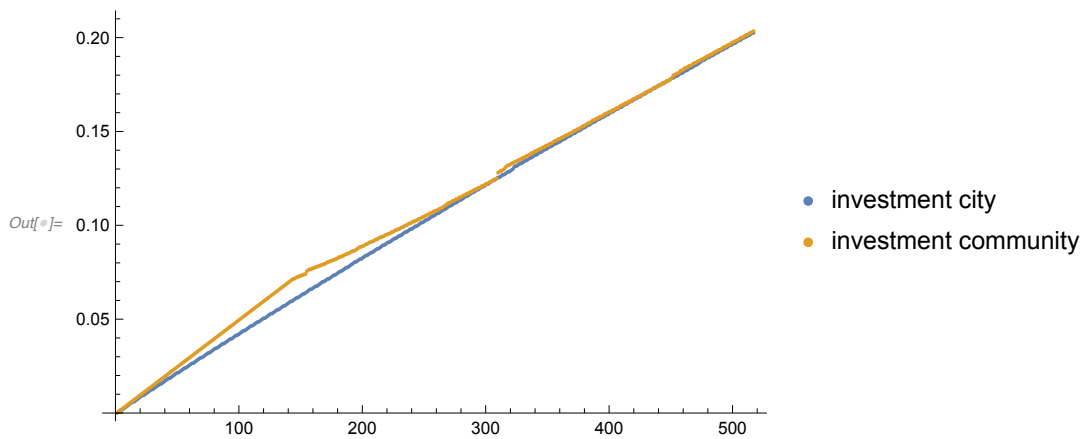
```
In[ ]:= Position[consumecity[[1 ;; 517]] - priceupdate,
  Max[consumecity[[1 ;; 517]] - priceupdate]]
```

```
Out[ ]:= {{143}, {144}}
```

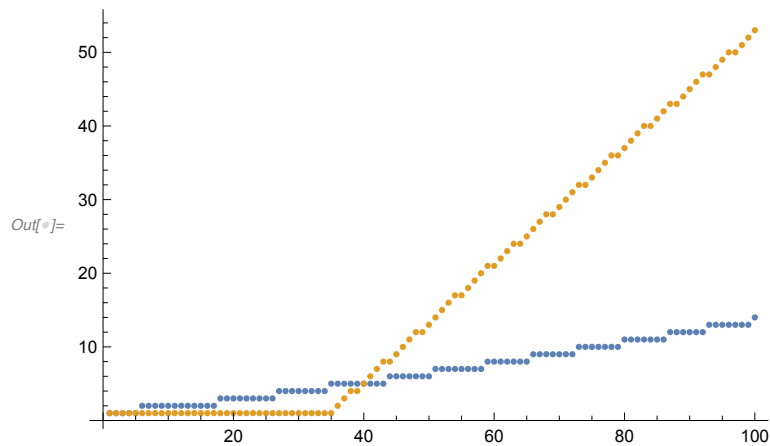
```
In[ ]:= ListPlot[{consumecity[[1 ;; 517]], priceupdate}]
```



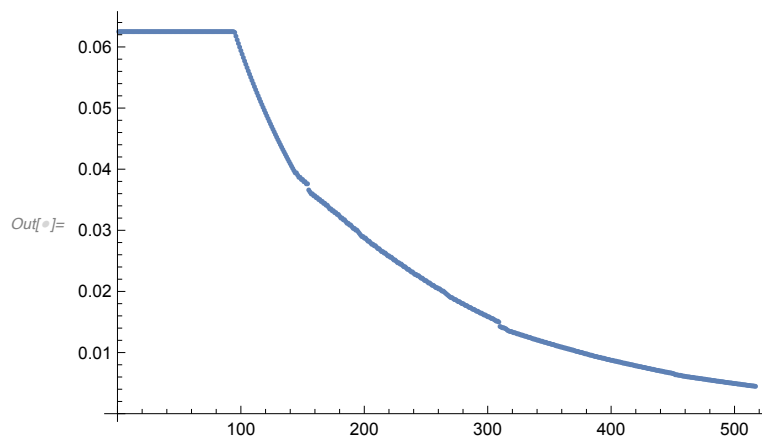
```
In[ ]:= ListPlot[{wealth[[1 ;; 517]] - Table[wealth[[consumecity[[i]]]], {i, 1, 517}],
  wealth[[1 ;; 517]] - Table[wealth[[priceupdate[[i]]]], {i, 1, 517}],
  PlotLegends -> {"investment city", "investment community"}]
```



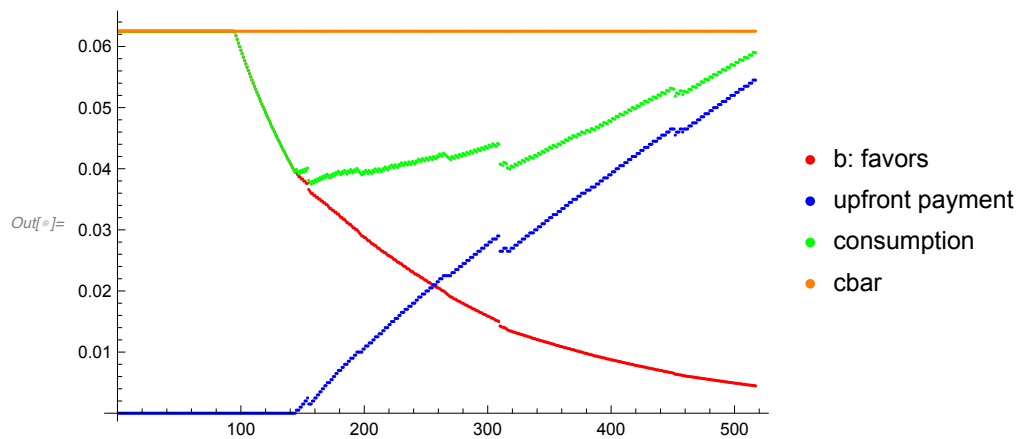
```
In[ ]:= ListPlot[{consumecity[[1 ;; 100]], priceupdate}]
```



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



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



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

Out[ ]:= 517

```
In[•]:= Length[wealthupdate]
```

$Out[\bullet]=$  517

```
ln[•]:= {N[{wealth[[wtre]], wealthupdate[[wtre]]}]}
```

$$Out[\bullet] = \{ \{0.258, 0.291124\} \}$$

(\* the following is the wealth dynamics  
in the long run which was not used in the paper.)

```
wupper0 = Ra[Ra[wbar]]; wupper = Ra[Ra[Ra[wbar]]]; grid = 1/2000;
```

```
wealth = Table[w, {w, 0, wupper + grid, grid}];
```

```
in[""]:= priceupdatetotal = Flatten[
  {priceupdate, consumecity[[Length[priceupdate] + 1 ;; Length[consumecity]]],
  Table[Round[(c / grid + 1) /. NSolve[R[wealth[[i]] - c] == wealth[[i]], c][[1]]],
  {i, Length[Table[j, {j, 1, wupper0 / grid}]] + 1, Length[wealth]}]}]
```

[illegible]



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[illegible]

[illegible]

[illegible]

[illegible]

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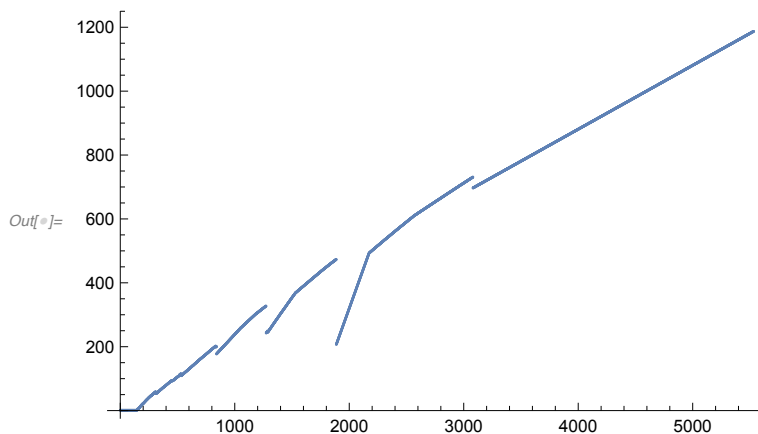
1151, 1151, 1151, 1152, 1152, 1152, 1152, 1152, 1153, 1153, 1153, 1153, 1153,
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1185, 1185, 1185, 1185, 1186, 1186, 1186, 1186, 1186, 1187, 1187, 1187, 1187}

```

```
In[ ]:= Length[priceupdatetotal]
```

```
Out[ ]:= 5532
```

```
In[ ]:= ListPlot[priceupdatetotal]
```



```

In[ ]:= Table[wealth[[i]] - c /. NSolve[R[wealth[[i]] - c] == wealth[[i]], c][[1]],
  {i, Length[Table[j, {j, 1, wupper0/grid}]] + 1,
    Length[Table[j, {j, 1, wupper0/grid}]] + 1}]

```

```
Out[ ]:= {1.192}
```

```

In[ ]:= Ranew[w_] := Piecewise[{{Ra[w], w ≤ 1192/1000}, {R[w], w > 1192/1000}}]
Rbnew[w_] := Piecewise[{{Rb[w], w ≤ 1192/1000}, {R[w], w > 1192/1000}}]

```



```
In[ ]:= T = 30;
Table[list[t] = Range[2^t], {t, 1, T}];
initial = wsel;
list[1] =
{Round[Rnew[wealth[[initial]] - wealth[[priceupdatetotal[[initial]]]]]/grid + 1],
 Round[Rbnew[wealth[[initial]] - wealth[[priceupdatetotal[[initial]]]]]/grid + 1]}
Out[ ]:= {816, 350}
```

```
In[ ]:= n = 2;
While[n < T + 1, list[n] = Flatten[Table[{Round[Rnew[wealth[[list[n - 1]][[j]]]] -
    wealth[[priceupdatetotal[[list[n - 1]][[j]]]]]/grid + 1],
    Round[Rbnew[wealth[[list[n - 1]][[j]]]] - wealth[[priceupdatetotal[[
    list[n - 1]][[j]]]]]/grid + 1}], {j, 1, Length[list[n - 1]]}];
    n++]
Out[ ]:= $Aborted
```

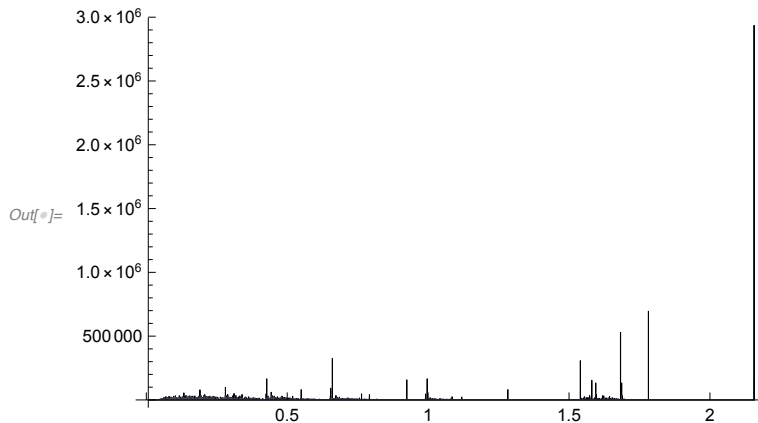
```
In[ ]:= listwealth = Table[wealth[[list[T]][[j]]], {j, 1, Length[list[T]]};
```

```
In[ ]:= Needs["Histograms`"]
```

```
In[ ]:= listwealth
```

```
Out[ ]:= { 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673, 673,
400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400, 400,
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673, 673, 673, ... 16 777 144 ..., 183, 39, 79, 17, 129, 69, 33, 141,
400, 400, 400, 2000, 1000, 2000, 1000, 400, 500, 200, 2000,
183, 157, 177, 19, 183, 157, 177, 19, 179, 77, 77, 33, 183, 157,
1000, 2000, 2000, 500, 1000, 2000, 2000, 500, 2000, 2000, 2000, 2000, 1000, 2000,
177, 19, 179, 77, 77, 33, 183, 39, 79, 17, 79, 17, 17, 7,
2000, 500, 2000, 2000, 2000, 2000, 2000, 2000, 1000, 2000, 1000, 2000, 1000, 1000, 1000 }
```

```
In[ ]:= Histogram[listwealth]
```



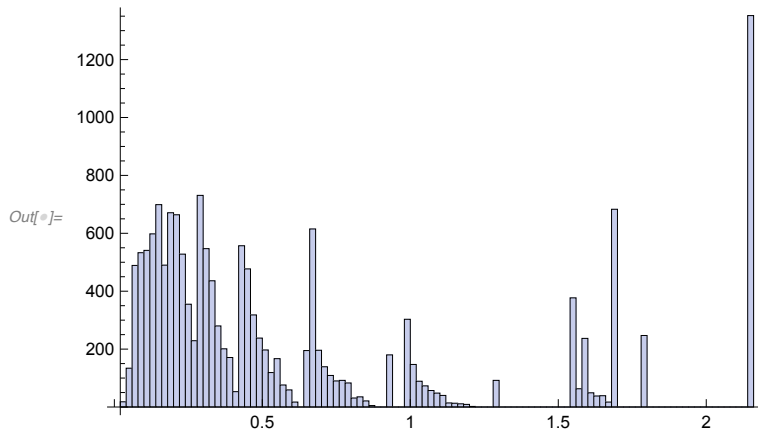
```
In[ ]:= N[wealth[[wsel]]]
```

```
Out[ ]:= 0.258
```

```
In[ ]:= {N[wealth[[Length[wealth]]]], N[Max[listwealth]]}
```

```
Out[ ]:= {2.7655, 2.1565}
```

```
In[ ]:= gcom = Histogram[listwealth]
```



```
In[ ]:= N[wealth[[wtre]]]
```

```
Out[ ]:= 0.028
```

```
In[ ]:= N[wealth[[wsel]]]
```

```
Out[ ]:= 0.0495
```

(\* starting from a wealth just above the selection margin, why is it so messy?

```
+++++
```

```
In[ ]:= wsel = 100
```

```
Out[ ]:= 100
```

```
In[ ]:= T = 14;
```

```
Table[listcity[t] = Range[2^t], {t, 1, T}];
```

```
initialcity = wsel;
```

```
In[ ]:= listcity[1] =
```

```
{Round[Ra[wealth[[initialcity]] - wealth[[consumecity[[initialcity]]]]] / grid + 1,
 Round[Rb[wealth[[initialcity]] - wealth[[consumecity[[initialcity]]]]] / grid + 1}
```

```
Out[ ]:= {141, 116}
```

```

In[ ]:= n = 2;
While[n < T+1, listcity[n] = Flatten[Table[{Round[Ra[wealth[[listcity[n-1][[j]]]] -
    wealth[[consumecity[[listcity[n-1][[j]]]]]]]/grid+1],
    Round[Rb[wealth[[listcity[n-1][[j]]]] - wealth[[consumecity[[
    listcity[n-1][[j]]]]]]]/grid+1}], {j, 1, Length[listcity[n-1]]}]];
    n++]

In[ ]:= listwealthcity = Table[wealth[[listcity[T][[j]]]], {j, 1, Length[listcity[T]]}];

In[ ]:= Needs["Histograms`"]

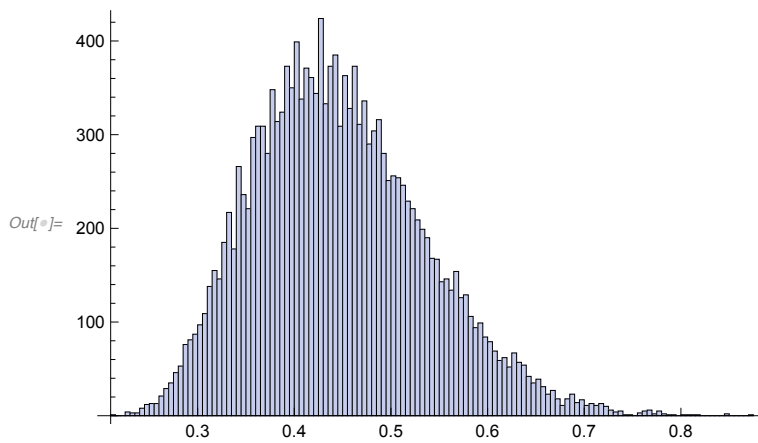
```

... **General:** Histograms` is now obsolete. The legacy version being loaded may conflict with current functionality. See the [Compatibility Guide](#) for updating information.

```

In[ ]:= gcity = Histogram[listwealthcity]

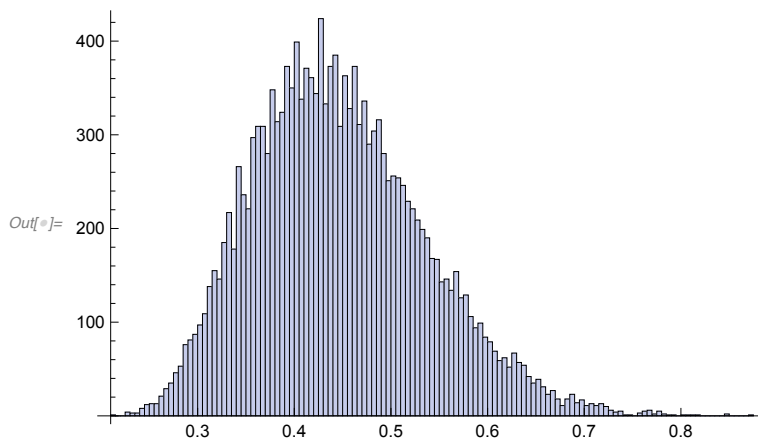
```



```

In[ ]:= Show[{gcity}]

```



In[ ]:= Show[{gcom, gcity}]

