# Chapter 12

## à Question 1

```
In[1]:= Needs["DiscreteMath`RSolve`"]

In[2]:= Needs["Graphics`MultipleListPlot`"]

In[3]:= Needs["Graphics`Legend`"]

In[4]:= Simplify[
          Solve[y == 110 + 0.75 (y1 + 80 - 0.2 y1) + 320 + 0.1 y1 + 330 + 440 - 10 - 0.2 y1, y]]

Out[4]= {{y → 1250. + 0.5 y1}}

In[5]:= soly0 = RSolve[{y[t] == 1320 + 0.5 y[t - 1], y[0] == 2500}, y[t], t]

Out[5]= {{y[t] → 2. (-70. 0.5^t + 1320. 1.^t)}}

In[6]:= oldy0 = Simplify[soly0[[1, 1, 2]]]

Out[6]= -140. 0.5^t + 2640. 1.^t
```

The difference equation which results is

$$Y_t = 1320 + 0.5\ Y_{t-2}$$

In order to solve this second order equation we require to make assumptions about the level of income in period 0 and period 1. We assume that in period 0 income is 2500 and in period 1 it is 2570.

```
In[7]:= soly1 = RSolve[{y[t] == 1320 + 0.5 y[t - 2], y[0] == 2500, y[1] == 2570}, y[t], t]

Out[7]= {{y[t] → 2500. (0.207107 (-0.707107)^t - 1.20711 0.707107^t + 2. 1.^t) +
            70. If[t ≥ 1, -0.292893 (-0.707107)^t - 1.70711 0.707107^t + 2. 1.^t, 0] -
            1250. If[t ≥ 2, 0.414214 (-0.707107)^t - 2.41421 0.707107^t + 2. 1.^t, 0]}}

In[8]:= newy1 = Simplify[soly1[[1, 1, 2]]]

Out[8]= 517.767 (-0.707107)^t - 3017.77 0.707107^t + 5000. 1.^t +
          70. If[t ≥ 1, -0.292893 (-0.707107)^t - 1.70711 0.707107^t + 2. 1.^t, 0] -
          1250. If[t ≥ 2, 0.414214 (-0.707107)^t - 2.41421 0.707107^t + 2. 1.^t, 0]
```

*In[9]:=*
```
pathy01 = Table[{t, oldy0, newy1}, {t, 0, 20}];
TableForm[pathy01, TableHeadings -> {{}, {"t", "y0(t)", "y1(t)"}}]
```

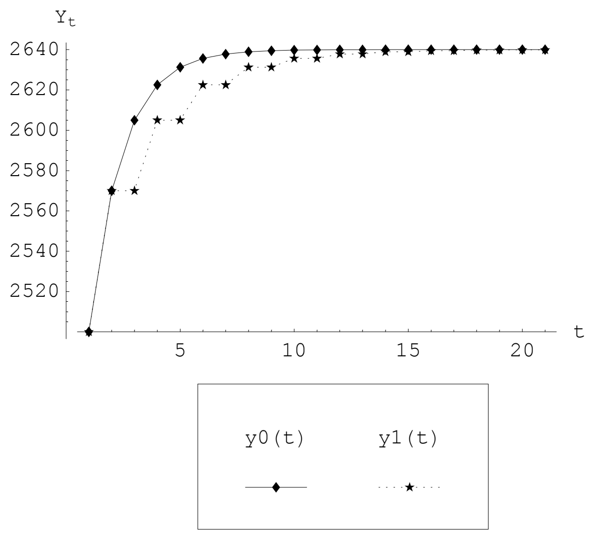
*Out[10]//TableForm=*

| t | y0(t) | y1(t) |
|---|---|---|
| 0 | 2500. | 2500. |
| 1 | 2570. | 2570. |
| 2 | 2605. | 2570. |
| 3 | 2622.5 | 2605. |
| 4 | 2631.25 | 2605. |
| 5 | 2635.63 | 2622.5 |
| 6 | 2637.81 | 2622.5 |
| 7 | 2638.91 | 2631.25 |
| 8 | 2639.45 | 2631.25 |
| 9 | 2639.73 | 2635.62 |
| 10 | 2639.86 | 2635.62 |
| 11 | 2639.93 | 2637.81 |
| 12 | 2639.97 | 2637.81 |
| 13 | 2639.98 | 2638.91 |
| 14 | 2639.99 | 2638.91 |
| 15 | 2640. | 2639.45 |
| 16 | 2640. | 2639.45 |
| 17 | 2640. | 2639.73 |
| 18 | 2640. | 2639.73 |
| 19 | 2640. | 2639.86 |
| 20 | 2640. | 2639.86 |

*In[11]:=*
```
points0 = Table[oldy0, {t, 0, 20}];
```

*In[12]:=*
```
points1 = Table[newy1, {t, 0, 20}];
```

*In[13]:=*
```
MultipleListPlot[points0, points1,
  PlotRange -> All, AxesOrigin -> {0, 2500}, PlotJoined -> True,
  AxesLabel -> {"t", "Yt"}, PlotLegend -> {"y0(t)", "y1(t)"},
    LegendPosition -> {-0.35, -1.2},
    LegendOrientation -> Horizontal,
    LegendSize -> {1, .5}];
```



# à Question 2

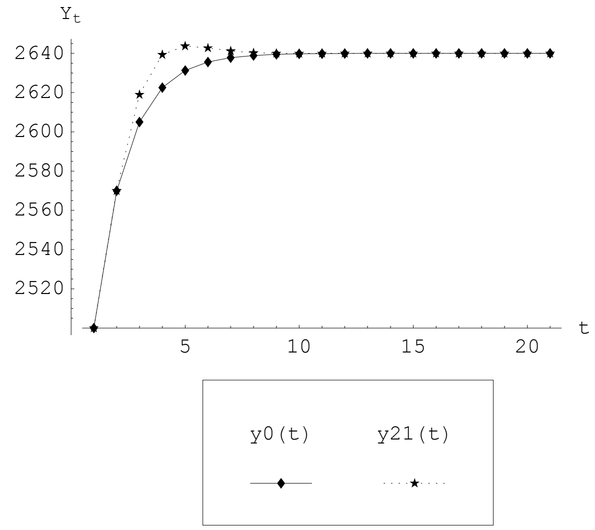
(i)

The new resulting difference equation is

$$Y_t = 1320 + 0.7\, Y_{t-1} - 0.2\, Y_{t-2}$$

```
In[14]:= soly21 = RSolve[
           {y[t] == 1320 + 0.7 y[t - 1] - 0.2 y[t - 2], y[0] == 2500, y[1] == 2570}, y[t], t]

         General::spell1 :
          Possible spelling error: new symbol name "soly21" is similar to existing symbol "soly1".

Out[14]= {{y[t] → -5. (2500. ((0.1 - 0.0179605 i) (0.35 - 0.278388 i)^t +
               (0.1 + 0.0179605 i) (0.35 + 0.278388 i)^t - 0.4 1.^t) -
            1680. If[t ≥ 1, (0.1 - 0.0179605 i) (0.35 - 0.278388 i)^(-1+t) +
               (0.1 + 0.0179605 i) (0.35 + 0.278388 i)^(-1+t) - 0.4 1.^(-1+t), 0. + 0. i] +
            500. If[t ≥ 2, (0.1 - 0.0179605 i) (0.35 - 0.278388 i)^(-2+t) +
               (0.1 + 0.0179605 i) (0.35 + 0.278388 i)^(-2+t) - 0.4 1.^(-2+t), 0. + 0. i])}}

In[15]:= newy21 = Simplify[soly21[[1, 1, 2]]]

         General::spell1 :
          Possible spelling error: new symbol name "newy21" is similar to existing symbol "newy1".

Out[15]= (-1250. + 224.507 i) (0.35 - 0.278388 i)^t -
          (1250. + 224.507 i) (0.35 + 0.278388 i)^t + 5000. 1.^t +
          8400. If[t ≥ 1, (0.1 - 0.0179605 i) (0.35 - 0.278388 i)^(-1+t) +
             (0.1 + 0.0179605 i) (0.35 + 0.278388 i)^(-1+t) - 0.4 1.^(-1+t), 0. + 0. i] -
          2500. If[t ≥ 2, (0.1 - 0.0179605 i) (0.35 - 0.278388 i)^(-2+t) +
             (0.1 + 0.0179605 i) (0.35 + 0.278388 i)^(-2+t) - 0.4 1.^(-2+t), 0. + 0. i]

In[16]:= points21 = Table[newy21, {t, 0, 20}];

         General::spell1 :
          Possible spelling error: new symbol name "points21" is similar to existing symbol "points1".
```

```
In[17]:= MultipleListPlot[points0, points21,
           PlotRange -> All, AxesOrigin -> {0, 2500}, PlotJoined -> True,
           AxesLabel -> {"t", "Yt"}, PlotLegend -> {"y0(t)", "y21(t)"},
             LegendPosition -> {-0.35, -1.2},
             LegendOrientation -> Horizontal,
             LegendSize -> {1, .5}];
```




(ii)

The resulting difference equation is

$$Y_t = 1320 + 0.5\, Y_{t-1}$$

which is the same equation as in Question 1, and hence the same time path for income.

## à Question 3

Since $NX_t = X_t - M_t$ and $X_t = X_0$ while $M_t = M_0 + m\, Y_t$, then

$$NX_t = (X_0 - M_0) - m\, Y_t$$

$$\Delta NX_t = -m\, \Delta Y_t$$

But

$$k_t = \frac{\Delta Y_t}{\Delta G}$$

Therefore

$$\Delta NX_t = -m\, k_t\, \Delta G$$

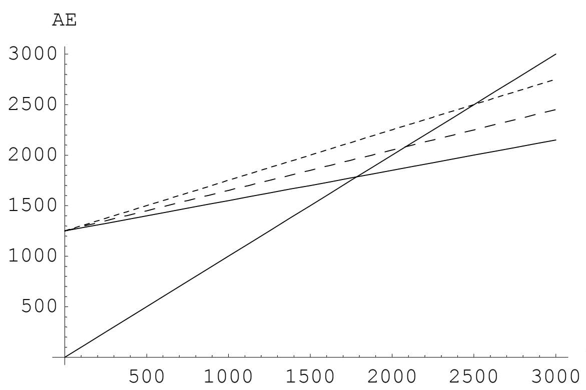
Also

$$\lim_{t \to \infty}(m\, k_t) = m \lim_{t \to \infty} k_t = m\, k$$

## à Question 4

(i) - (ii)

```
In[18]:= Simplify[
          Solve[y == 110 + 0.75 (y1 + 80 - 0.2 y1) + 320 + 0.1 y1 + 330 + 440 - 10 - 0.2 y1, y]]

Out[18]= {{y → 1250. + 0.5 y1}}

In[19]:= Solve[ystar1 == 1250 + 0.5 ystar1, ystar1]

Out[19]= {{ystar1 → 2500.}}

In[20]:= Simplify[
          Solve[y == 110 + 0.75 (y1 + 80 - 0.2 y1) + 320 + 0.1 y1 + 330 + 440 - 10 - 0.3 y1, y]]

Out[20]= {{y → 1250. + 0.4 y1}}

In[21]:= Solve[ystar2 == 1250 + 0.4 ystar2, ystar2]

Out[21]= {{ystar2 → 2083.33}}

In[22]:= Simplify[
          Solve[y == 110 + 0.75 (y1 + 80 - 0.2 y1) + 320 + 0.1 y1 + 330 + 440 - 10 - 0.4 y1, y]]

Out[22]= {{y → 1250. + 0.3 y1}}

In[23]:= Solve[ystar3 == 1250 + 0.3 ystar3, ystar3]

Out[23]= {{ystar3 → 1785.71}}

In[24]:= Plot[{y, 1250 + 0.5 y, 1250 + 0.4 y, 1250 + 0.3 y},
           {y, 0, 3000}, AxesLabel -> {"Y", "AE"},
             PlotStyle -> {{}, {Dashing[{.01}]}, {Dashing[{.02}]}}];
```




(iii)

```
In[25]:= sol1 = RSolve[{y[t] == 2500 + 0.5 y[t - 1], y[0] == 2000}, y[t], t]

         General::spell1 :
          Possible spelling error: new symbol name "sol1" is similar to existing symbol "soly1".
```

Out[25]= {{y[t] → 2. (-1500. $0.5^t$ + 2500. $1.^t$)}}

```
In[26]:= path1 = Simplify[sol1[[1, 1, 2]]]
```

Out[26]= -3000. $0.5^t$ + 5000. $1.^t$

```
In[27]:= list1 = Table[{path1}, {t, 0, 20}];
```

```
In[28]:= sol2 = RSolve[{y[t] == 2500 + 0.4 y[t - 1], y[0] == 2000}, y[t], t]
```

$$\{\{y[t] \to 2.5\,(-866.667\;0.4^{t} + 1666.67\;1.^{t})\}\}$$

```
In[29]:= path2 = Simplify[sol2[[1, 1, 2]]]
```

$$-2166.67\;0.4^{t} + 4166.67\;1.^{t}$$

```
In[30]:= list2 = Table[path2, {t, 0, 20}];
```

```
In[31]:= sol3 = RSolve[{y[t] == 2500 + 0.3 y[t - 1], y[0] == 2000}, y[t], t]
```

$$\{\{y[t] \to 3.33333\,(-471.429\;0.3^{t} + 1071.43\;1.^{t})\}\}$$

```
In[32]:= path3 = Simplify[sol3[[1, 1, 2]]]
```

$$-1571.43\;0.3^{t} + 3571.43\;1.^{t}$$

```
In[33]:= list3 = Table[path3, {t, 0, 20}];
```

```
In[34]:= TableForm[{{list1, list2, list3}},
          TableHeadings -> {{}, {"m=0.2", "m=0.3", "m=0.4"}}]
```

Out[34]//TableForm=

| m=0.2 | m=0.3 | m=0.4 |
|---|---|---|
| 2000. | 2000. | 2000. |
| 3500. | 3300. | 3100. |
| 4250. | 3820. | 3430. |
| 4625. | 4028. | 3529. |
| 4812.5 | 4111.2 | 3558.7 |
| 4906.25 | 4144.48 | 3567.61 |
| 4953.13 | 4157.79 | 3570.28 |
| 4976.56 | 4163.12 | 3571.08 |
| 4988.28 | 4165.25 | 3571.33 |
| 4994.14 | 4166.1 | 3571.4 |
| 4997.07 | 4166.44 | 3571.42 |
| 4998.54 | 4166.58 | 3571.43 |
| 4999.27 | 4166.63 | 3571.43 |
| 4999.63 | 4166.65 | 3571.43 |
| 4999.82 | 4166.66 | 3571.43 |
| 4999.91 | 4166.66 | 3571.43 |
| 4999.95 | 4166.67 | 3571.43 |
| 4999.98 | 4166.67 | 3571.43 |
| 4999.99 | 4166.67 | 3571.43 |
| 4999.99 | 4166.67 | 3571.43 |
| 5000. | 4166.67 | 3571.43 |

(iv)

Thus, the higher the marginal propensity to import, the lower the equilibrium value of income and the sooner the economy reaches equilibrium for a given level of income.

## à Question 5

The IS curve is given by equation (12.13)

$$r = \frac{a + \mathrm{nx}_0 + (f+g)\,R}{h} - \frac{[1 - c(1-t) - j + m]\,y}{h}$$

while the LM curve is given by equation (12.19)

$$r = \frac{\mathrm{m0}}{u} - \left(\frac{k}{u}\right) y$$

Note, however, that in Table 12.2 *nx*0 is contained in the value of the parameter *a*. The BP curve is given by

$$r = \left(r^{*} - \frac{\mathrm{bp0} + (f+g)\,R}{v}\right) + \left(\frac{m}{v}\right) y$$

The initial values are given by

```
In[35]:= intIS = (a + (f + g) R)/h
```

$$\frac{a + (f + g)\, R}{h}$$

Out[35]= $\frac{a + (f + g)\, R}{h}$

In[36]:= slopeIS = $-\frac{(1 - c\,(1 - t) - j + m)}{h}$

Out[36]= $-\frac{1 - j + m - c\,(1 - t)}{h}$

```
In[37]:= intIS0 = intIS /. {a -> 43.5, f -> 5, g -> 2, R -> 1.764, h -> 2}
Out[37]= 27.924

In[38]:= slopeIS0 = slopeIS /. {c -> 0.75, t -> 0.3, j -> 0, m -> 0.2, h -> 2}
Out[38]= -0.3375

In[39]:= intLM = -m0 / u
```

Out[39]= $-\frac{m0}{u}$

```
In[40]:= slopeLM = k / u
```

Out[40]= $\frac{k}{u}$

```
In[41]:= intLM0 = -m0 / u  /. {m0 -> 3, u -> 0.5}
Out[41]= -6.

In[42]:= slopeLM0 = slopeLM /. {k -> 0.25, u -> 0.5}
Out[42]= 0.5
```

In[43]:= intBP = rstar $-\frac{bp0 + (f + g)\, R}{v}$

Out[43]= rstar $-\frac{bp0 + (f + g)\, R}{v}$

In[44]:= slopeBP = $\frac{m}{v}$

Out[44]= $\frac{m}{v}$

```
In[45]:= intBP0 = intBP /. {rstar -> 15, bp0 -> -3.5, f -> 5, g -> 2, R -> 1.764, v -> 1}
Out[45]= 6.152

In[46]:= slopeBP0 = slopeBP /. {m -> 0.2, v -> 1}
Out[46]= 0.2
```

Initial equilibrium values are given by

```
In[47]:= Solve[{r == intIS0 + slopeIS0 * y, r == intLM0 + slopeLM0 * y}, {y, r}]
Out[47]= {{y → 40.5063, r → 14.2531}}
```

The BP curve also intersects at the same values since

```
In[48]:= Solve[{r == intIS0 + slopeIS0 * y, r == intBP0 + slopeBP0 * y}, {y, r}]

Out[48]= {{y → 40.506, r → 14.2532}}
```

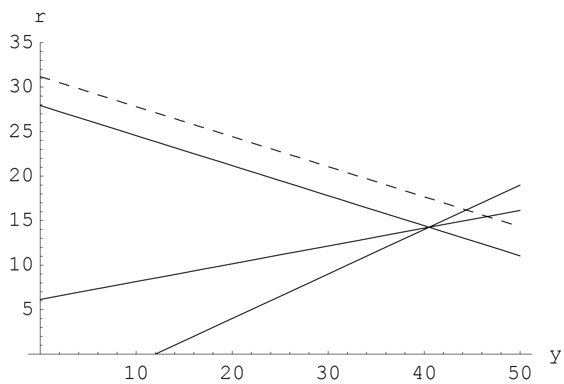
Also note that

```
In[49]:= bp = (x0 - z0) + (f + g) R - m y + cf0 + v (r - rstar)

Out[49]= cf0 + (f + g) R + (r - rstar) v + x0 - m y - z0

In[50]:= bp0 = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.764, m -> 0.2,
           cf0 -> 20.5, v -> 1, rstar -> 15, y -> 40.506, r -> 14.2532}

Out[50]= 0.
```

(i) **Rise in *a* from 43.5 to 50**

The change in the parameter *a* affects only the IS curve, shifting it to the right. The IS curve will intersect the LM curve at a higher income level and a higher interest rate. With the higher interest rate and the real exchange rate constant, there will be a capital inflow and the balance of payments will go into surplsu. To verify these statements:

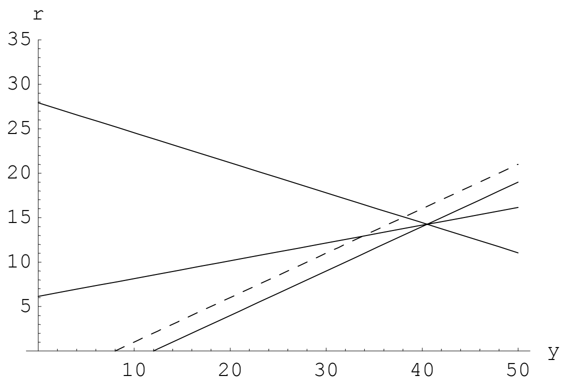
```
In[51]:= intIS1 = intIS /. {a -> 50, f -> 5, g -> 2, R -> 1.764, h -> 2}

Out[51]= 31.174

In[52]:= Solve[{r == intIS1 + slopeIS0 * y, r == intLM0 + slopeLM0 * y}, {y, r}]

Out[52]= {{y → 44.3869, r → 16.1934}}

In[53]:= bp1 = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.764, m -> 0.2,
           cf0 -> 20.5, v -> 1, rstar -> 15, y -> 44.3869, r -> 16.1934}

Out[53]= 1.16402

In[54]:= Plot[{intIS0 + slopeIS0 * y, intLM0 + slopeLM0 * y, intBP0 + slopeBP0 * y,
           intIS1 + slopeIS0 * y}, {y, 0, 50}, PlotRange -> {0, 35},
          AxesLabel -> {"y", "r"}, PlotStyle -> {{}, {}, {}, {Dashing[{.02}]}}];
```




(ii) **A fall in *m*0 from 3 to 2**

A fall in the money supply shifts the LM curve left, leaving the IS curve and the BP curve unaffected. There is a resulting rise in the rate of interest and a fall in the level of income. The new LM curve intersects the IS curve above the BP curve. The increased interest rate leads to a capital inflow and an improvement in the balance of payments.

```
In[55]:= intLM2 = intLM /. {m0 -> 2, u -> 0.5}

Out[55]= -4.

In[56]:= Solve[{r == intIS0 + slopeIS0 * y, r == intLM2 + slopeLM0 * y}, {y, r}]

Out[56]= {{y → 38.1182, r → 15.0591}}

In[57]:= bp2 = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.764, m -> 0.2,
            cf0 -> 20.5, v -> 1, rstar -> 15, y -> 38.1182, r -> 15.0591}

Out[57]= 1.28346

In[58]:= Plot[{intIS0 + slopeIS0 * y, intLM0 + slopeLM0 * y, intBP0 + slopeBP0 * y,
            intLM2 + slopeLM0 * y}, {y, 0, 50}, PlotRange -> {0, 35},
           AxesLabel -> {"y", "r"}, PlotStyle -> {{}, {}, {}, {Dashing[{.02}]}}];
```

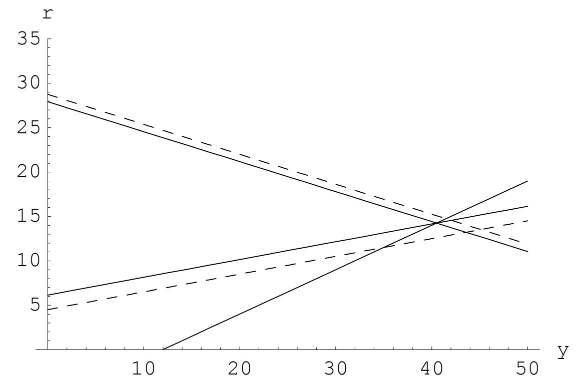



(iii) **Devaluation: rise in *R* from 1.764 to 2**

A devaluation, rise in *R*, shifts the IS curve right and the BP curve down, leaving the LM curve unaffected. There results a rise in income and a rise in the rate of interest. The rise in the interest rate leads to a capital inflow and an improvement in the balance of payments. In the case of all shifts only the intercepts change.

```
In[59]:= intIS3 = intIS /. {a -> 43.5, f -> 5, g -> 2, R -> 2, h -> 2}

Out[59]= 28.75

In[60]:= intBP3 = intBP /. {rstar -> 15, bp0 -> -3.5, f -> 5, g -> 2, R -> 2, v -> 1}

Out[60]= 4.5

In[61]:= Solve[{r == intIS3 + slopeIS0 * y, r == intLM0 + slopeLM0 * y}, {y, r}]

Out[61]= {{y → 41.4925, r → 14.7463}}

In[62]:= bp3 = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 2, m -> 0.2,
            cf0 -> 20.5, v -> 1, rstar -> 15, y -> 41.4925, r -> 14.7463}

Out[62]= 1.9478
```

```
In[63]:= Plot[{intIS0 + slopeIS0 * y, intLM0 + slopeLM0 * y,
            intBP0 + slopeBP0 * y, intIS3 + slopeIS0 * y, intBP3 + slopeBP0 * y},
          {y, 0, 50}, PlotRange -> {0, 35}, AxesLabel -> {"y", "r"},
          PlotStyle -> {{}, {}, {}, {Dashing[{.02}]}, {Dashing[{.02}]}}];
```




## à Question 6

(i) **Rise in autonomous spending by 20**

With a rise in autonomous spending of 10, the new intercept for the IS curve rises by $\Delta a/h = 20/2 = 10$, to the value 37.924.

```
In[64]:= Solve[{r == 37.924 - 0.3375 y, r == -6 + 0.5 y}, {y, r}]

Out[64]= {{y → 52.4466, r → 20.2233}}
```

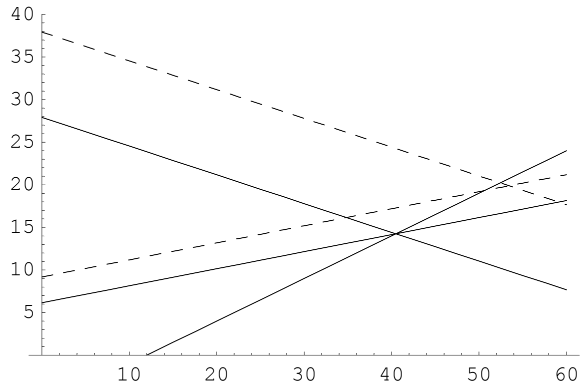
To solve for *bp* we use the information in Table 12.2 and the solution values just derived.

```
In[65]:= newbp = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.764, m -> 0.2,
            cf0 -> 20.5, v -> 1, rstar -> 15, y -> 52.4466, r -> 20.2233}

Out[65]= 3.58198
```

Under a floating exchange rate, the resulting surplus on the balance of payments leads to an appreciation of the exchange rate (*S* appreciates, and with *P* and *P** constant, *R* appreciates by the same amount). The value of *R* falls to 1.33.

```
In[66]:= intIS6 = intIS /. {a -> 63.5, f -> 5, g -> 2, R -> 1.33, h -> 2}

Out[66]= 36.405

In[67]:= intBP6 = intBP /. {rstar -> 15, bp0 -> -3.5, f -> 5, g -> 2, R -> 1.33, v -> 1}

Out[67]= 9.19

In[68]:= Solve[{r == 36.405 - 0.3375 y, r == -6 + 0.5 y}, {y, r}]

Out[68]= {{y → 50.6328, r → 19.3164}}

In[69]:= bp6 = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.33, m -> 0.2,
            cf0 -> 20.5, v -> 1, rstar -> 15, y -> 50.6328, r -> 19.3164}

Out[69]= -0.00016
```

```
In[70]:= Plot[{27.924 - 0.3375 y, -6 + 0.5 y, 6.152 + 0.2 y,
            37.924 - 0.3375 y, 9.19 + 0.2 y}, {y, 0, 60}, PlotRange -> {0, 40},
          PlotStyle -> {{}, {}, {}, {Dashing[{.02}]}, {Dashing[{.02}]}}];
```




(ii) **A rise in the money supply from 3 to 4**

```
In[71]:= Solve[{r == 27.924 - 0.3375 y, r == -8 + 0.5 y}, {y, r}]

Out[71]= {{y → 42.8943, r → 13.4472}}
```

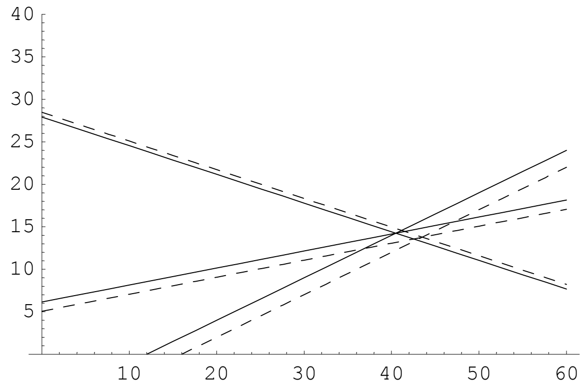
To solve for *bp* we use the information in Table 12.2 and the solution values just derived.

```
In[72]:= newbp = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.764, m -> 0.2,
            cf0 -> 20.5, v -> 1, rstar -> 15, y -> 42.8943, r -> 13.4472}

Out[72]= -1.28366
```

Under a floating exchange rate, the resulting deficit on the balance of payments leads to a depreciation of the exchange rate (*S* depreciates, and with *P* and *P** constant, *R* depreciates by the same amount). The value of *R* rises to 1.92.

```
In[73]:= intIS62 = intIS /. {a -> 43.5, f -> 5, g -> 2, R -> 1.92, h -> 2}

Out[73]= 28.47

In[74]:= intBP62 = intBP /. {rstar -> 15, bp0 -> -3.5, f -> 5, g -> 2, R -> 1.92, v -> 1}

Out[74]= 5.06

In[75]:= Solve[{r == 28.47 - 0.3375 y, r == -8 + 0.5 y}, {y, r}]

Out[75]= {{y → 43.5463, r → 13.7731}}

In[76]:= bp62 = bp /. {x0 -> 0, z0 -> 24, f -> 5, g -> 2, R -> 1.92, m -> 0.2,
            cf0 -> 20.5, v -> 1, rstar -> 15, y -> 43.5463, r -> 13.7731}

        General::spell1 :
         Possible spelling error: new symbol name "bp62" is similar to existing symbol "bp2".

Out[76]= 0.00384
```

```
In[77]:= Plot[{27.924 - 0.3375 y, -6 + 0.5 y, 6.152 + 0.2 y, -8 + 0.5 y, 28.47 - 0.3375 y,
            5.06 + 0.2 y}, {y, 0, 60}, PlotRange -> {0, 40}, PlotStyle ->
            {{}, {}, {}, {Dashing[{.02}]}, {Dashing[{.02}]}, {Dashing[{.02}]}}];
```




## à Question 7

```
In[78]:= Clear[y, r, s]

In[79]:= Solve[{0 == 2.675 - 0.03375 y - 0.1 r + 0.35 s, 0 == -2.4 + 0.2 y - 0.4 r,
          0 == -0.00185 - 0.00002 y + 0.0001 r + 0.0007 s}, {y, r, s}]

Out[79]= {{y → 45.5696, r → 16.7848, s → 1.54702}}

In[80]:= RSolve[{y[t + 1] == 2.675 + (1 - 0.03375) y[t] - 0.1 r[t] + 0.35 s[t],
          r[t + 1] == -2.4 + 0.2 y[t] + 0.6 r[t],
          s[t + 1] == -0.00185 - 0.00002 y[t] + 0.0001 r[t] + 1.0007 s[t],
          y[0] == 40.506, r[0] == 14.253, s[0] == 1.764}, {y[t], r[t], s[t]}, t]

        RowReduce::luc :
         Result for RowReduce of badly conditioned matrix <<1>> may contain significant numerical errors.

Out[80]= {}
```

Therefore, *Mathematica* provides no output for this problem.

## à Question 8

```
In[81]:= Solve[{0 == 2.675 - 0.03375 y - 0.1 r + 0.35 s,
          0 == -2.4 + 0.2 y - 0.4 r, 0 == -0.925 - 0.01 y + 0.05 r + 0.35 s}, {y, r, s}]

Out[81]= {{y → 45.5696, r → 16.7848, s → 1.54702}}

In[82]:= RSolve[{y[t + 1] == 2.675 + (1 - 0.03375) y[t] - 0.1 r[t] + 0.35 s[t],
          r[t + 1] == -2.4 + 0.2 y[t] + 0.6 r[t],
          s[t + 1] == -0.925 - 0.01 y[t] + 0.05 r[t] + 1.35 s[t], y[0] == 40.506,
          r[0] == 14.253, s[0] == 1.764}, {y[t], r[t], s[t]}, t]

        RowReduce::luc :
         Result for RowReduce of badly conditioned matrix <<1>> may contain significant numerical errors.

Out[82]= {}
```

Again *Mathematica* does not provide an answer because of the numerical inaccuracies.