Solutions to Exercises of Chapter 13 (Week 10)

Macroeconomics

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Exercise 1

(a) $$R_t - \bar{r} = \bar{m}\,(\pi_t - \bar{\pi})$$

$\bar{r} = 2\%$, $\bar{m} = 1/2$, $\bar{\pi} = 2\%$

Let's solve just for three cases: $\pi = 10\%$, $\pi = 2\%$ and $\pi = 1\%$. In order to obtain the level of the nominal interest rate we have to use the Fisher Equation

$$i_t = R_t + \pi_t$$

Therefore, we have

$$\pi_t = 10\% \Rightarrow R_t = (1/2)(10\% - 2\%) + 2\% = 6\%$$

$$\Rightarrow i_t = 6\% + 10\% = 16\%$$

$$\pi_t = 2\% \Rightarrow R_t = (1/2)(2\% - 2\%) + 2\% = 2\%$$

$$\Rightarrow i_t = 2\% + 2\% = 4\%$$

$$\pi_t = 1\% \Rightarrow R_t = (1/2)(1\% - 2\%) + 2\% = 1.5\%$$

$$\Rightarrow i_t = 1.5\% + 1\% = 2.5\%$$

(b) Let us consider now the case of $\overline{m} = 1$.

We will have:

$$\pi_t = 10\% \Rightarrow R_t = (10\% - 2\%) + 2\% = 10\%$$

$$i_t = 10\% + 10\% = 20\%$$

$$\pi_t = 2\% \Rightarrow R_t = (2\% - 2\%) + 2\% = 2\%$$

$$i_t = 2\% + 2\% = 4\%$$

$$\pi_t = 1\% \Rightarrow R_t = (1\% - 2\%) + 2\% = 1\%$$

$$i_t = 1\% + 1\% = 2\%$$

Notice that when $\pi_t = 2\% = \overline{\pi}$ the results are the same for both cases (when $\overline{m} = 1/2$ and $\overline{m} = 1$):

$$\overline{\pi}_t = 2\% \;\Big|\; \begin{array}{l} m = 1/2 \Rightarrow i_t = 4\% \\ m = 1 \Rightarrow i_t = 4\% \end{array}$$

But what happens if $\pi_t \neq \overline{\pi}$?

The results we get are showing very well what the parameter $\overline{m}$ tells us: the higher $\overline{m}$, the more aggressive is the Central Bank in fighting inflation:

$\pi_t = 10\%$ | $\overline{m} = 0.5 \Rightarrow i_t = 16\%$

$\overline{m} = 1 \Rightarrow i_t = 20\%$

For the same level of inflation (10%), the Central Bank sets i_t at a much higher level for $\overline{m} = 1$.

Notice that when $\pi_t < \overline{\pi}$, we will have the opposite situation. In order to fight a situation in which $\pi_t < \overline{\pi}$, the Central Bank will set i_t at a lower level when $\overline{m} = 1$.

$\pi_t = 1\%$ | $\overline{m} = 0.5 \Rightarrow i_t = 2\%$

$\overline{m} = 1 \Rightarrow i_t = 1.5\%$.

One important point that is not asked in this question is what happens to i_t when the Central Bank raises the target level of inflation ($\bar{\pi}$). Let us consider the possibility that the Central Bank raises $\bar{\pi}$ to 4%. What happens (consider only the case in which $m = 1/2$ and $\pi_t = 10\%$)?

$$R_t = (1/2)(10\% - 4\%) + 2\% = 5\%$$

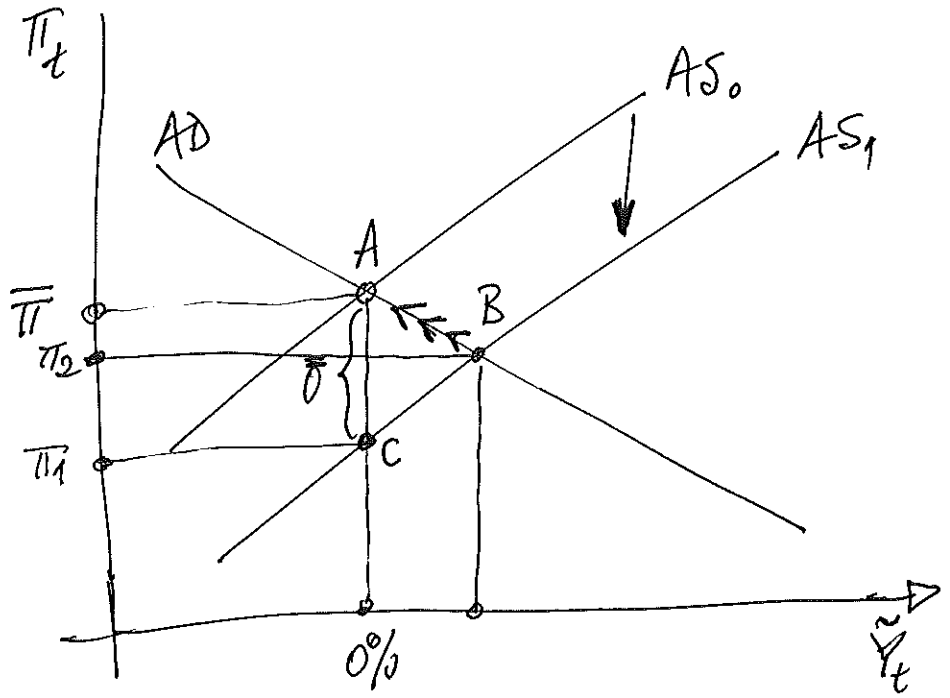
And what happens to i_t?

$$i_t = R_t + \pi_t = 5\% + 10\% = 15\%$$

Notice that if $\bar{\pi} = 2\%$ we had $i_t = 16\%$. So pay attention that if the central bank decides to increase its target level for inflation ($\bar{\pi}$), it will have to reduce nominal interest rates (i_t).

Exercise 3

This exercise deals with a case that is precisely the opposite to what we saw in slides 22 and 23 of week 10. In the case we have here there is a negative oil price shock. The answer is as follows (follow the steps in the figure below):



A: this is the initial equilibrium point.

B: The economy is hit by the negative shock in oil prices, and the AS shifts from AS_0 to AS_1.

When the economy is hit by the shock, if the central bank does not react to lower inflation and keeps its interest rate unchanged, the economy would move down to point C, having a much lower inflation of π_1.

But usually the central bank reacts to the negative shock by reducing nominal interest rates. If it does so, lower interest rates will lead to higher aggregate demand (as Investment and Consumption will go up), and the economy moves to point B, not point C.

The impact of lower oil prices and lower interest rates have created a boom at B. And we know that if the economy is in a boom, then the AS curve tells us that inflation will have to increase over time because:

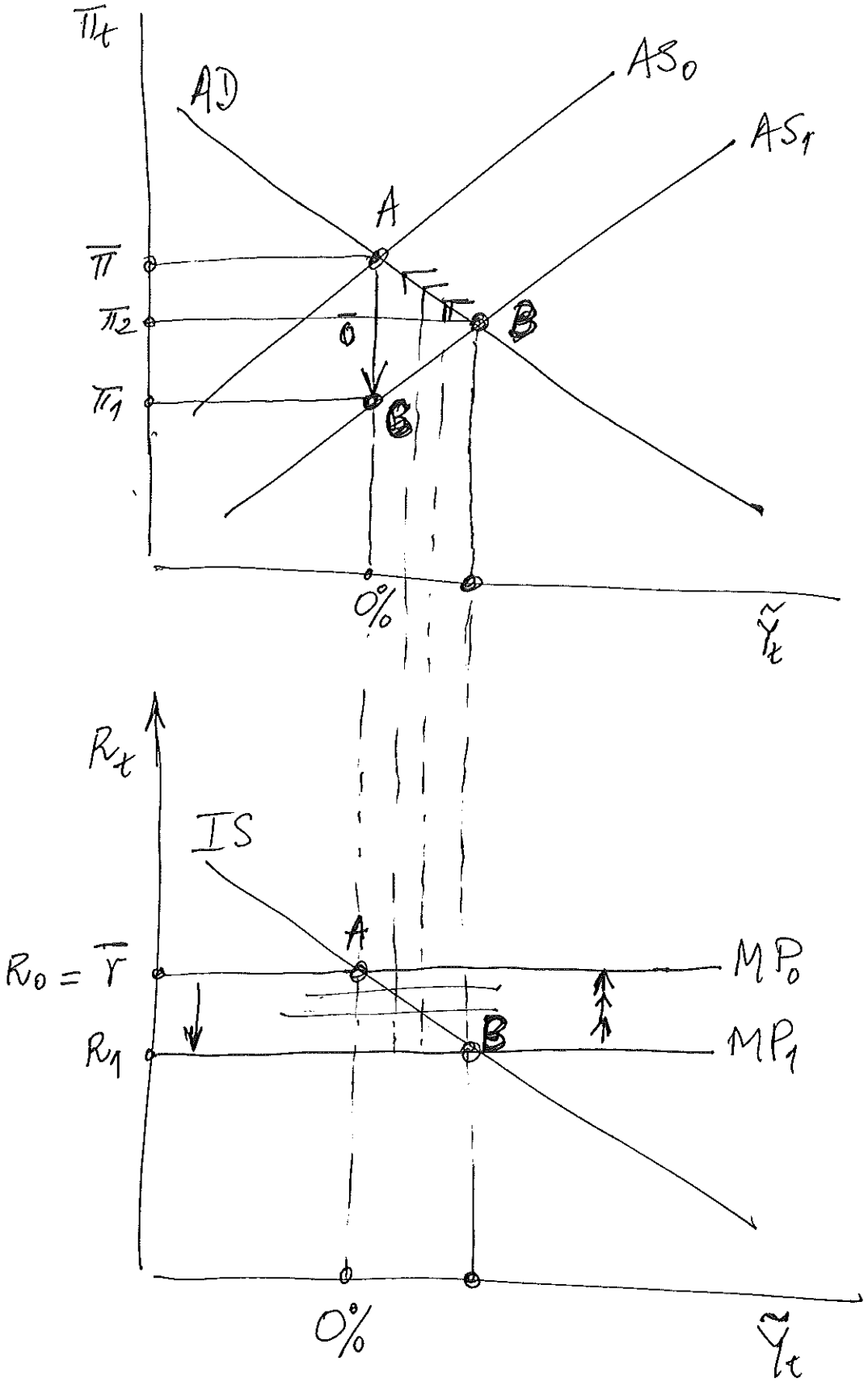
$$\pi_t = \pi_{t-1} + \bar{v}\,\tilde{Y}_t \quad \Big| \quad \text{If } \tilde{Y}_t > 0, \text{ then } \pi_t > \pi_{t-1}$$

This increase in inflation will turn the economy back to point A, gradually.

Obviously, when the rate of inflation is returning back to its original level, gradually, the central bank will increase short term interest rates following the increase in inflation.

Finally, the economy will return to point A, where $\pi_t = \bar{\pi}$, and $\tilde{Y}_t = 0\%$. The central bank just acted as a cushion to better accomodate the oil price shock.

If you want to see in the entire model (AD/AS and IS/MP) just take a look at the next figure. The central bank reduces interest rates from R_0 to R_1 and forces the economy to move into point B, not point C. At B we have a boom, and, therefore, inflation will start to increase, gradually, from B to A. When this happens, the central bank will increase its interest rate, following the increase in inflation. Inflation is back to its initial level; interest rates are back to their initial levels as well, and $\tilde{Y}_t = 0$.

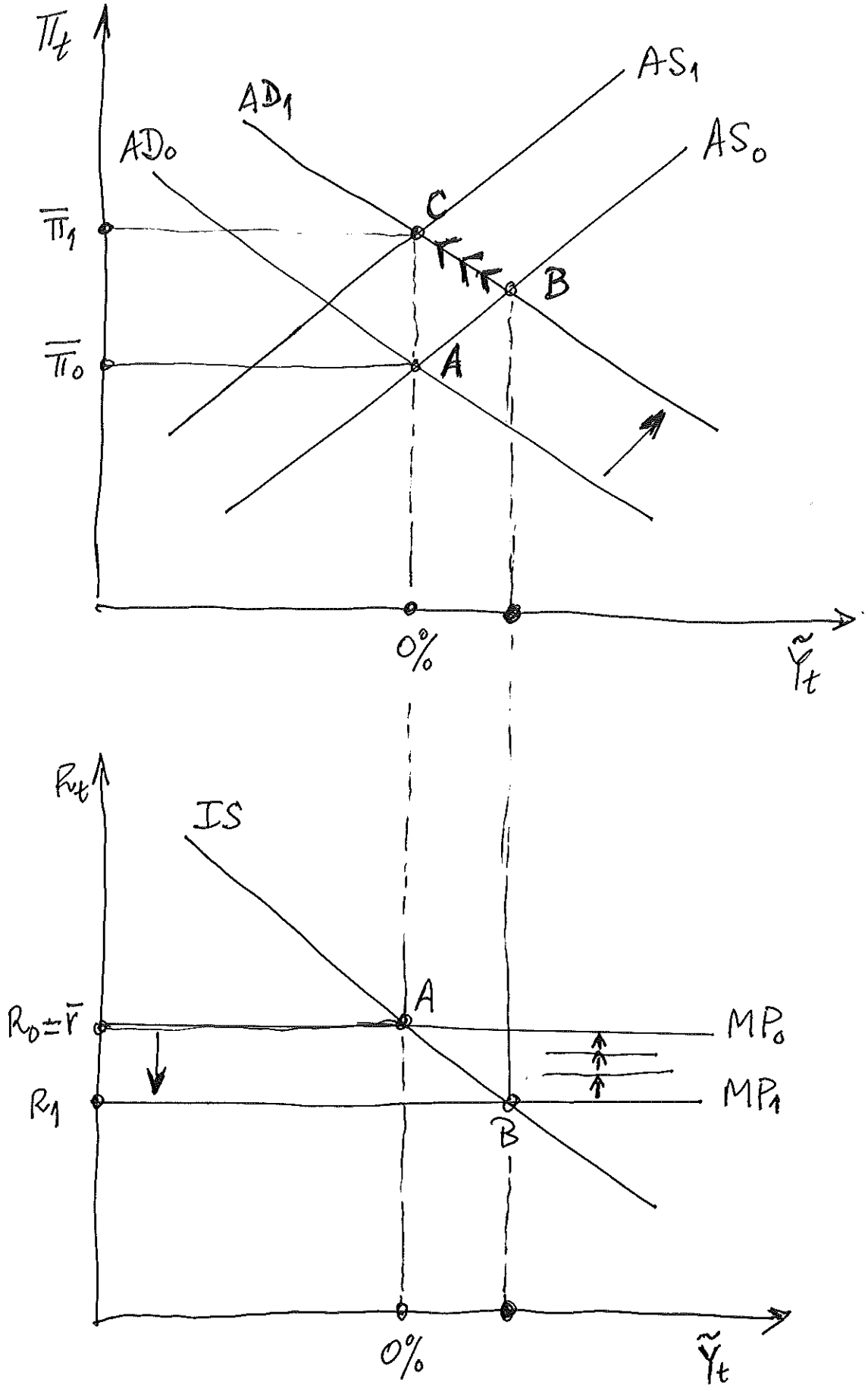

π_t
AD
AS_0
AS_1
A
$\bar{\pi}$
π_2
π_1
B
C
0%
$\tilde{Y}_t$
R_t
IS
A
$R_0 = \bar{r}$
R_1
B
MP_0
MP_1
0%
$\tilde{Y}_t$

Exercise 6 (It is convenient to solve this exercise before we solve exercise 5)

Exercise 6 is precisely the opposite case to what we saw in slides 25 and 26 of week 10. We have here a case where the central bank of Japan wants to re-inflate the economy: that is, to achieve a higher target rate of inflation ($\overline{\pi}_1 > \overline{\pi}_0$).

You should remember from exercise (1), page 4, that if the central bank wants to increase $\overline{\pi}$, will have to reduce interest rates. This leads to an economic boom, moving the economy from point A to point B in the following figure.

If we have a boom, then the AS curve will have to shift leftwards, representing an increase in inflation. If inflation is going up, then the central bank will have to adjust the nominal interest rate (by increasing this rate), until the economy is moving from B to C. Point C is the new equilibrium, with a higher π_t and the same R_t. Obviously, the central bank will have a higher <u>nominal</u> interest rate.

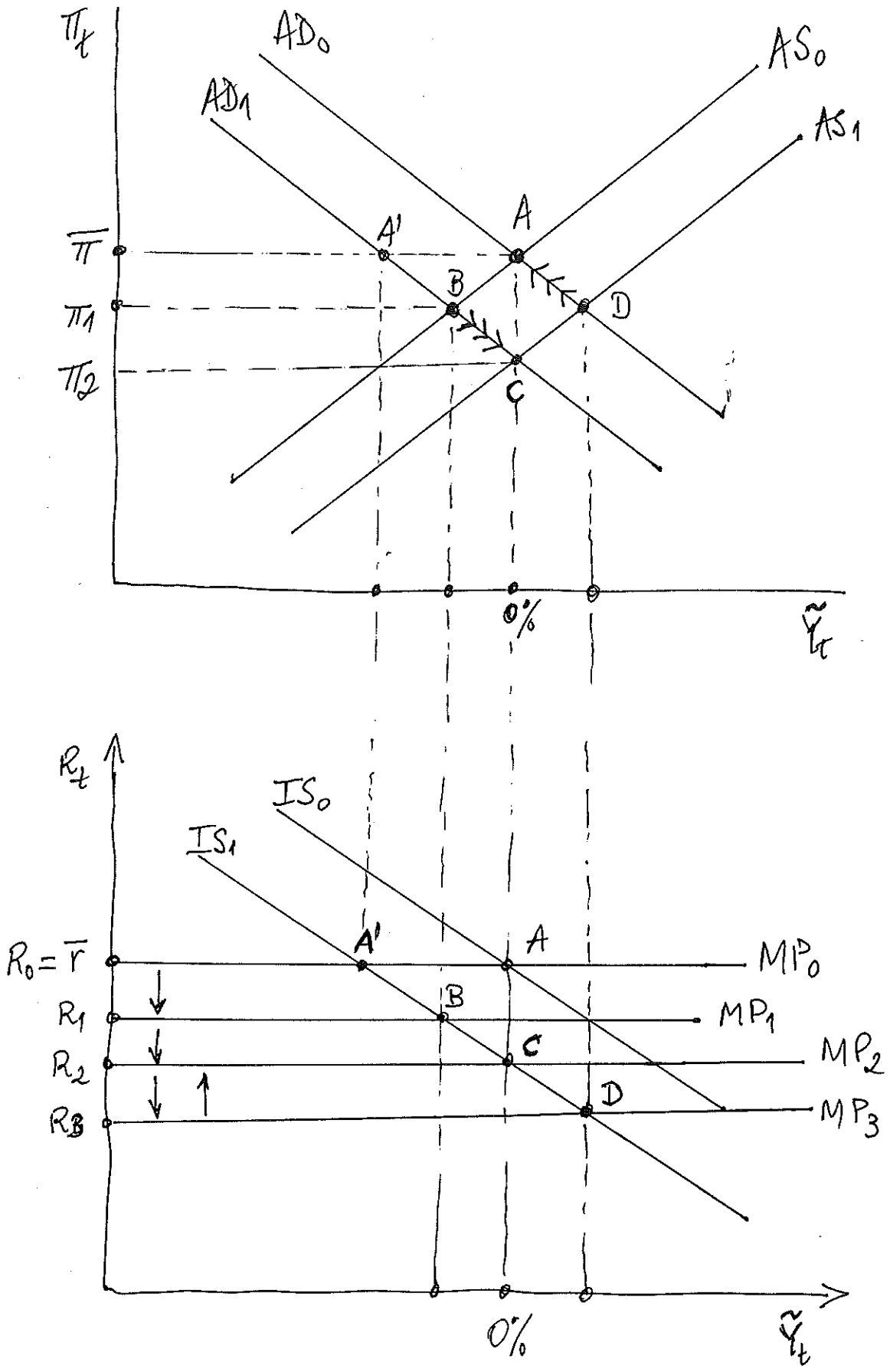

π_t
AS_1
AD_1
AD_0
AS_0
C
$\bar{\pi}_1$
B
$\bar{\pi}_0$
A
0%
$\tilde{Y}_t$
R_t
IS
A
$R_0 = \bar{r}$
MP_0
R_1
MP_1
B
0%
$\tilde{Y}_t$

Exercise 5

this is a situation that is precisely the opposite to what we saw in slides 28, 29 and 30 of week 10. In our case here, we have a negative AD shock: there is a decline in net exports.

As you can see in the following figure such a shock will move the AD_0 to AD_1. Point B will be the next point where the economy will arrive at, where we have lower inflation (π_1) and lower real interest rates (R_1). But given that at B we are in a recession, inflation will have to come down and the AS_0 will start moving to AS_1. With lower inflation than at B, the central bank will reduce further real interest rates (R_2) and the economy will arrive at point C.

Notice that point C can be the new equilibrium point if the central bank accepts π_2 as the target for inflation: $\tilde{Y}_t = 0$ and $\overline{\pi}_{new} = \pi_2$. However, usually a central bank will not accept π_2 as the new


π_t
AD_0
AD_1
AS_0
AS_1
$\bar{\pi}$
π_1
π_2
A'
A
B
C
D
0%
$\tilde{Y}_t$
R_t
IS_0
IS_1
$R_0 = \bar{r}$
R_1
R_2
R_3
MP_0
MP_1
MP_2
MP_3
A'
A
B
C
D
0%
$\tilde{Y}_t$

target. If this happens, and if in the meantime there is no positive shock to the AD such that AD_1 moves back to AD_0 (like an increase in government spending, or an increase in the optimism of consumers or investors), the central bank has no other option besides re-inflating the economy, moving it out of the trap at point C.

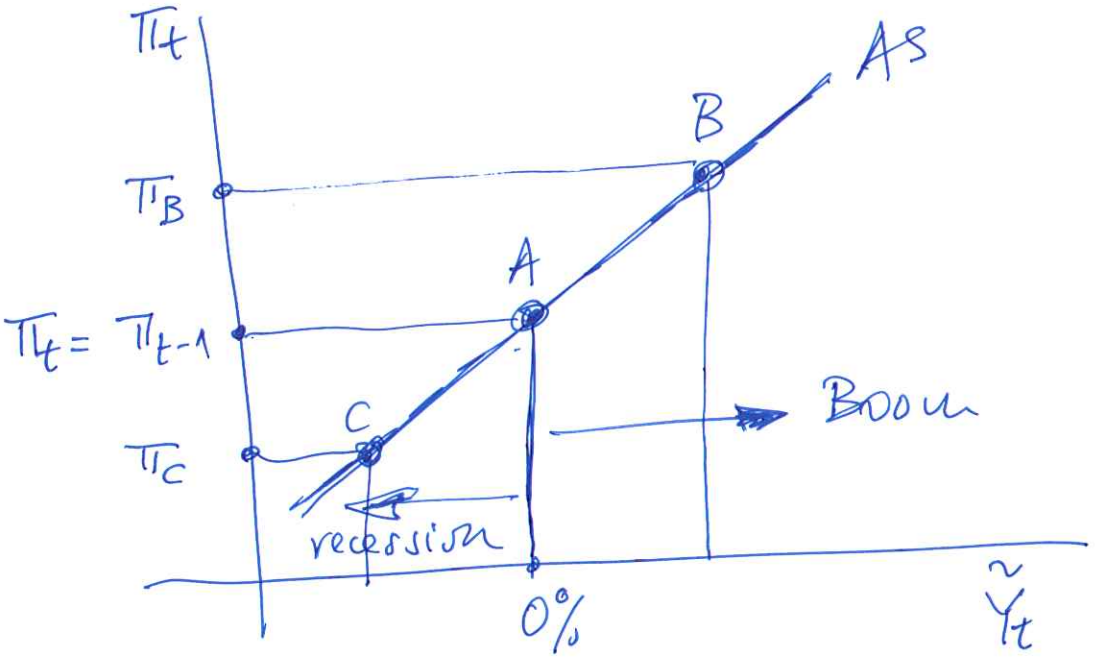
The re-inflation issue is already known by you, as we have already discussed such problem in exercise 6. In order to re-inflate the economy the central bank has to further reduce interest rates (from R_2 to R_3), and this increases investment and consumption, leading to a boom at point D, where the "new" AD_0 crosses AS_1.

At point D, the economy is in a boom, and we know that inflation will have to increase, shifting gradually the AS_1 curve back to AS_0. Eventually, the economy will reach its new equilibrium at A, with $\pi_t = \overline{\pi}$, and $\hat{Y}_t = 0\%$. Notice, however,

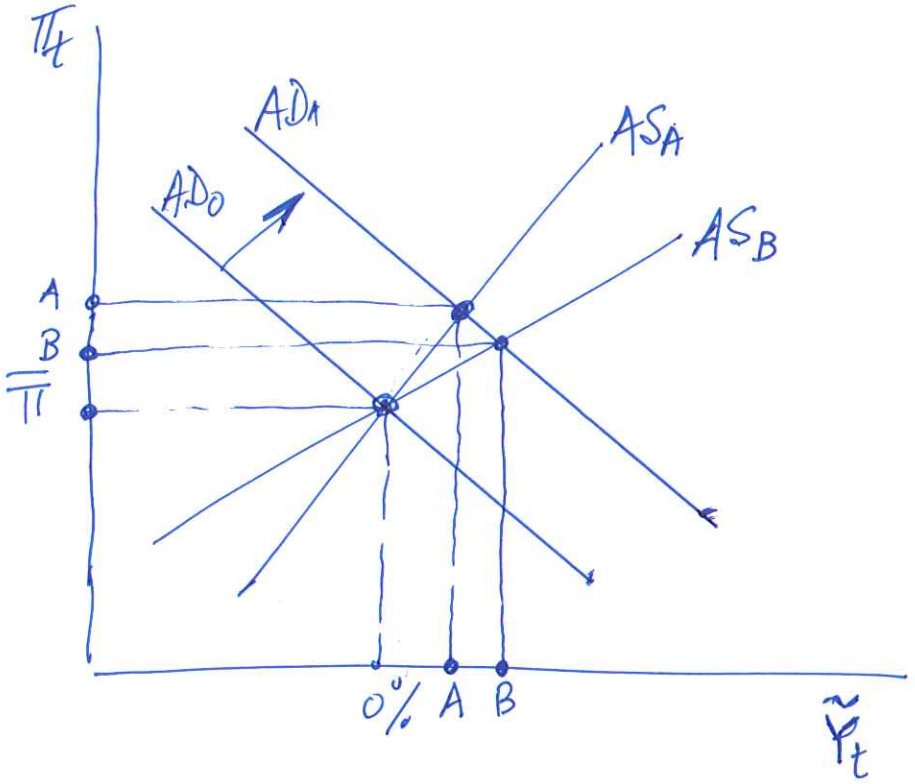
that in this new equilibrium, the real interest rate will have to be lower (R_2) than its initial level (R_0). This is the "price" the central bank will have to pay to keep $\pi_t = \bar{\pi}$; $\tilde{Y}_t = 0\%$ and lower net exports. Higher investment and consumption (due to lower real interest rates) compensates for lower net exports in the end.

Exercise 7

(a) The AS curve slopes upward because if the economy is in a boom (GDP above Potential GDP), productive factors are used above their potencial capacity, which leads to higher costs and to higher inflation. If the economy is in a recession, the opposite occurs and inflation should go down. Those points can be easily seen in the figure below



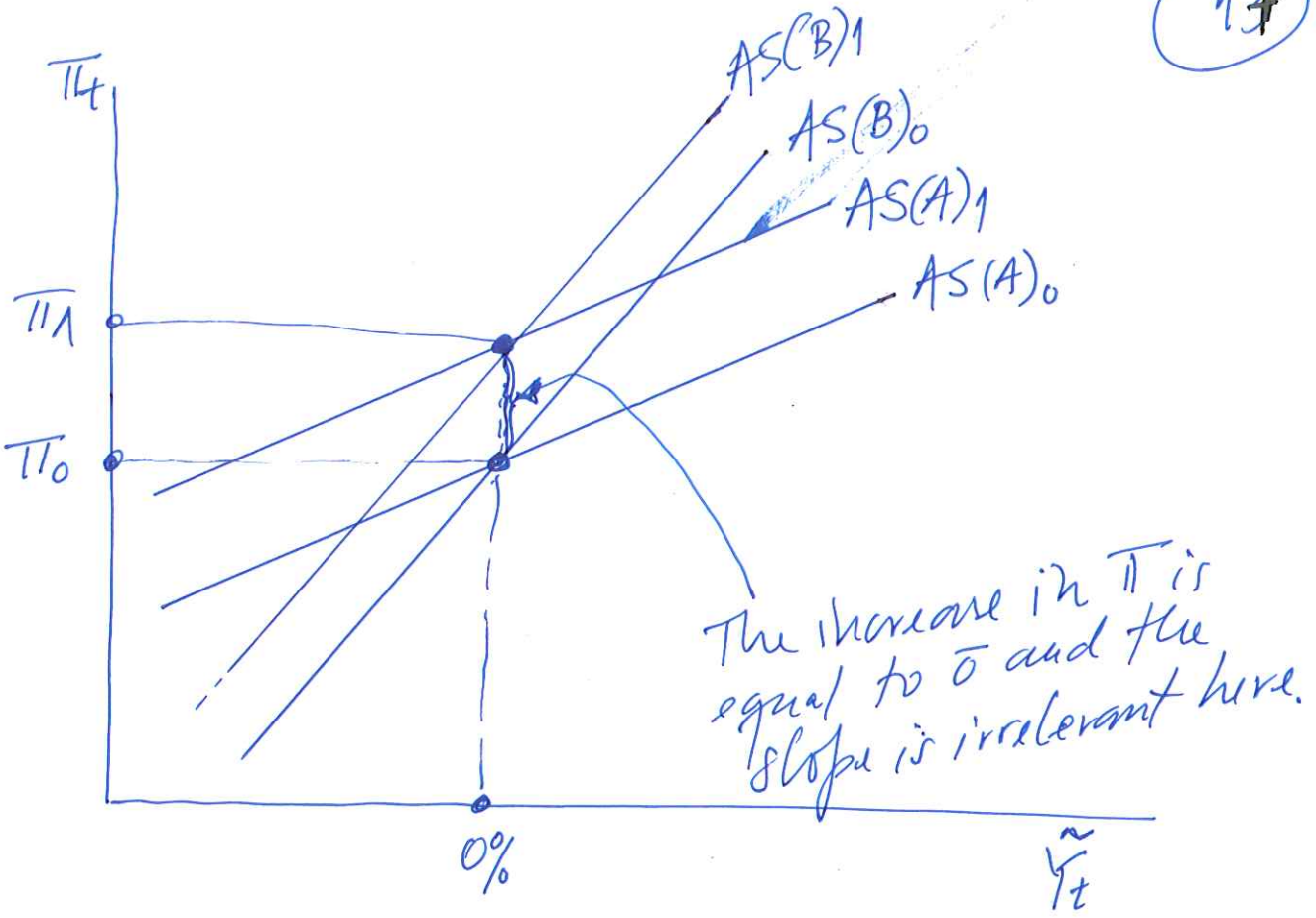
(b) If the AS curve is more steeply sloped, the same AD shock will lead to higher inflation and lower output gap, as follows



(c) If the AS curve is more steeply sloped, it will react to an AS shock as follows: <u>in the same way</u>. Because

$$\pi_t = \pi_{t-1} + \bar{v}\,\tilde{y}_t + \bar{o}$$

so $\frac{\partial \Delta\pi}{\partial \bar{o}} = 1$ independently from $\bar{v}$.



(d) Usually, if an economy lives for a long period with very low and stable inflation, private agents react very gently to changes in economic activity (or the output gap). By this, we mean that they do not expect inflation to increase a lot if the economy enters into an expansionary phase, and vice versa. In this case, the slope of the AS function is relatively small.

the curve will become steeper if private agents have lived under periods of very high inflation, and large economic instability! In this case, they know that if the Central Bank tries to stimulate AD (by reducing i_t), then inflation will increase a lot, as you can see in the figure in question (b).

Exercise 8

(a) The AD curve slopes downward because if inflation increases above target ($\bar{\pi}$), the Central Bank raises i_t, which leads to higher R_t, and consequently will lead to a reduction in Investment and Consumption. This will lead to a recession (lower $\tilde{Y}_t$).

(b) Shocks to $\bar{a}$ produce the same impact upon the economy independently of the slope of the AD curve. The expression of the AD is

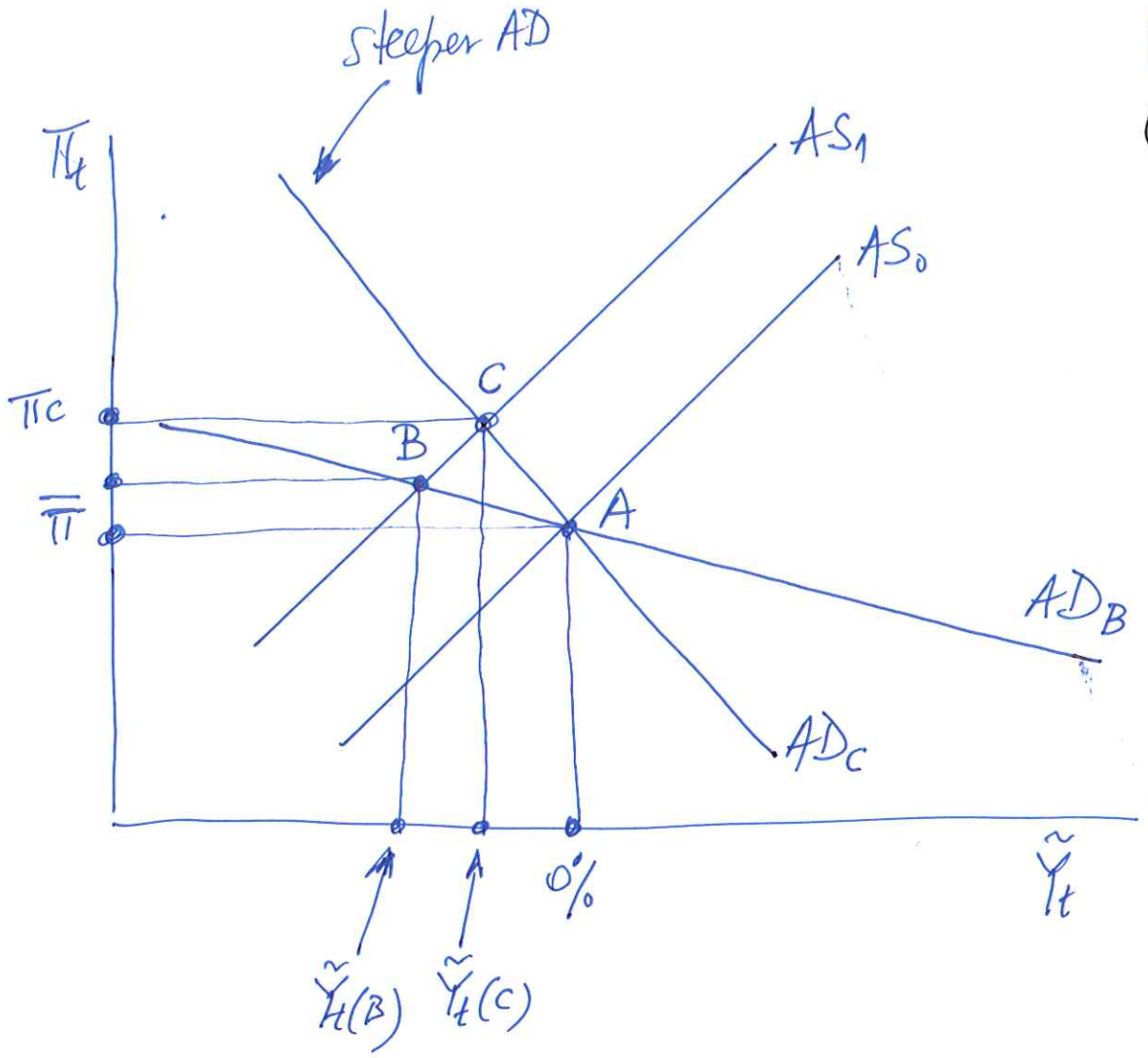
$$\tilde{Y}_t = \bar{a} - \bar{b}\bar{m}(\pi_t - \bar{\pi})$$

Therefore $\frac{\partial \tilde{Y}_t}{\partial \bar{a}}$ will be independent from its slope $(-\bar{b}\bar{m})$.

(c) If there is a supply shock (for example a positive shock), the impacts will be dependent on the slope of the AD curve.

see next figure

The steeper the AD curve, the larger will be the level of inflation (π_c) and the lower will be the reduction in the output gap ($\tilde{Y}_{t(c)}$).



(d) If Central Banks are very aggressive towards the fight against inflation ($\bar{\pi}$ will be higher than in the case where central banks are more passive towards inflation), the AD curve will be <u>flatter</u> not <u>steeper</u>. The logic is very simple: if they dislike inflation a lot they are not worried if, in order to fight inflation, they will cause a large

recession. This can be easily seen in the figure below. Suppose the Central Bank wants to keep inflation as close as possible to the target level. If there is a positive supply shock ($AS_0 \rightarrow AS_1$) in the case of an aggressive central bank the economy will move towards point A, while in the case of a central bank permissive with inflation, the economy will move to point B.