Exercise Class 3

Solutions

BESS - FOUNDATIONS OF ECONOMICS - 30453

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Note: This document contains exercises relative to the program of Macroeconomics by Blanchard-Amighini-Giavazzi (ch. 14,17,18). The program relies on the 3th edition of the book. Exercises are written by the author of the document or completely extrapolated from Ferraguto exercise textbook (5th edition).

Ch.14 - Financial Markets and Expectations

Exercise 1 (Q1, pg. 106 Ferraguto)

Suppose that the current short-term (one year) interest rate is 1%. Financial markets expect this interest rate to be equal to 1% also next year, to become 3% two years from now, and to remain constant at this higher level thereafter.

(a) Compute the t yield to maturity on bonds having maturity up to 5 years. What can you conclude about the yields on bonds with maturities greater than 5 years?

Solution This exercise is just a simple application of the long-term interest rate formula, applied to different yields to maturity:

$$i_{nt} \approx \frac{1}{n}(i_{1t} + x_{nt} + i^e_{1,t+1} + i^e_{1,t+2} + ... + i^e_{1,t+n-1}) \tag{1}$$

$$\begin{aligned}
i_{1t} &= 1\% \\
i_{2t} &= \frac{1}{2}(1\% + 1\%) = 1\% \\
i_{3t} &= \frac{1}{3}(1\% + 1\% + 3\%) = 1.7\% \\
i_{4t} &= \frac{1}{4}(1\% + 1\% + 3\% + 3\%) = 2\% \\
i_{5t} &= \frac{1}{5}(1\% + 1\% + 3\% + 3\% + 3\%) = 2.2\%
\end{aligned}$$

As n increases, $i_{nt} \to 3\%$

(b) Explain what the yield curve is and draw it for this economy, assuming existence of bonds with maturities up to 30 years.

Solution The yield curve is defined as the curve that relate bonds' maturities to their respective yields. In ordinary times it is upward sloping, i.e. yield is increasing in maturity.

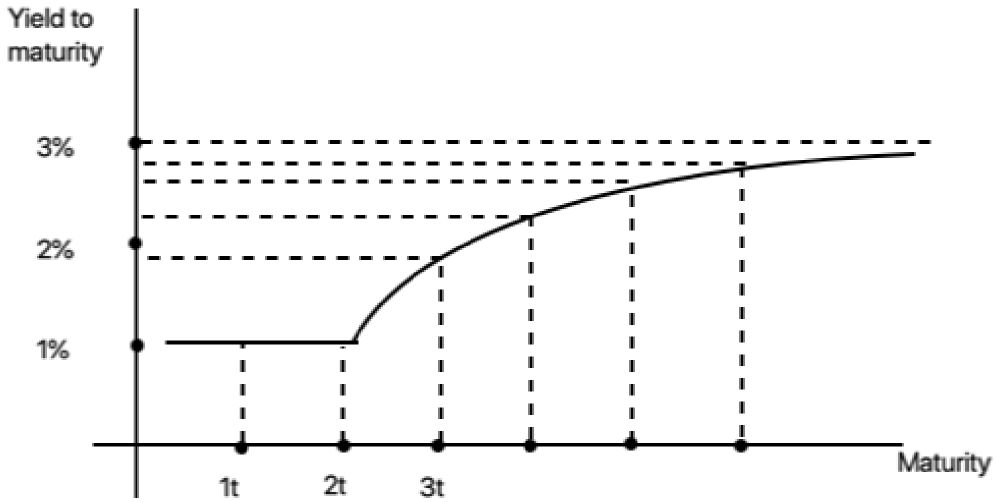


Figure 1: Yield Curve

Exercise 2 (Q4, pg. 112 Ferraguto)

Consider an economy with only 1 and 2-yrs bonds. We are at time t. The price at t of 2-yrs bonds is €P_{2t} = €94. The yield at $t+1$ maturing at $t+2$ is $i^e_{1,t+1} = 4\%$. Z_{t+2} = €100

(a) Compute 1-yr yield bond i_{1t}.

Solution First, we have to derive the 2-yrs yield. Given that, we can exploit the long-term interest rate formula that links current short-term rate and expected future rates:

$$P_{2t} = \frac{Z_{t+2}}{(1+i_{2t})^2}$$
$$94 = \frac{100}{(1+i_{2t})^2}$$
$$1 + i_{2t} = \sqrt{\frac{100}{94}}$$
$$i_{2t} = 1.0314 - 1 = 3.14\%$$

Plug it into the long-term formula:

$$
\begin{aligned}
i_{2t} &\approx \frac{1}{2}(i_t + i^e_{t+1}) \\
3.14\% &= 0.5 i_t + 2\% \\
i_t &= 2.28\%
\end{aligned}
$$

(b) Suppose now your expectation about future 1-yr rate is different from market expectations, $i^{e'}_{1,t+1} = 5\%$. If interested in how much you'll have from today, should you buy 2yr bonds or a sequence of 1-yr bonds? Or maybe indifferent between alternatives?

Solution Following your beliefs, an expected future 1-yr yield of 5% would require a 2-yr bond yield higher than what provided by the 2-yrs bond in the market.

$$
\begin{aligned}
i'_{2t} &= \frac{1}{2}(i_t + i^{e'}_{t+1}) \\
i'_{2t} &= \frac{1}{2}(2.26\% + 5\%) \\
i'_{2t} &= 3.64\%
\end{aligned}
$$

Therefore, since the actual available 2-yr rate is equal to $3.14\% < 3.64\%$, it is more convenient to invest in two 1-yr bonds.

Ch.17 - Openness in goods and financial markets

Exercise 1

Consider the following questions as a review of useful concepts for the incoming chapters.

(a) Define the **nominal exchange rate** between euro and dollar, in the **indirect** way (European), as used in the Blanchard.

Solution First, the indirect way of defining the exchange rate between two different currencies set the price of domestic currency in terms of foreign. Regarding euro/dollar, for us European the (direct) exchange rate is defined as €1 (domestic) in terms of corresponding dollars. Today, euro/dollar exchange rate is given by

$$1€ = 1.08\$$$
$$1 = \frac{1.08}{1}\frac{\$}{€}$$
$$E_{\$/€} = \frac{1.08}{1}\frac{\$}{€} = 1.08\frac{\$}{€}$$

(b) Define the **real exchange rate** between euro and dollar.

Solution The real exchange rate defines the price of domestic goods in terms of foreign goods, taking into account the nominal exchange rate between two different currencies.

$$E^R_{\$/€} = E_{\$/€}\frac{P}{P^*}$$

Where superscript R indicates real, P and P^* are domestic and foreign prices respectively.

While nominal exchange rate relates only the value of two currencies, the real exchange rate makes possible to compare the price of the same good in two different countries adopting different currencies.

Exercise 2

Given the nominal exchange rate of the previous exercise, compute the real exchange rate between the identical car X sold in different countries[1] (Italy, US). Prices:

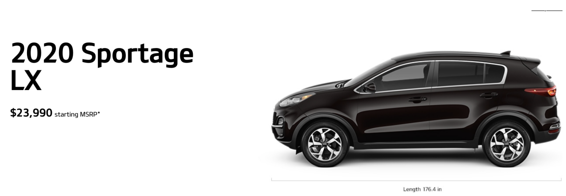
$$P = 26,750\ € \qquad P^* = 23,990\$$$

Solution

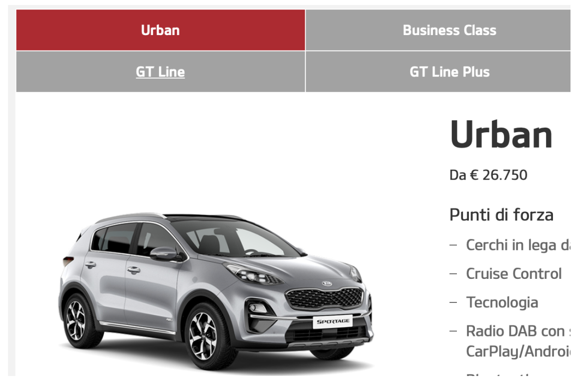
$$E^R_{\$/€} = E_{\$/€}\frac{P}{P^*} = 1.08\$/€\frac{26,750€}{23,990\$} = 1.20$$

In real terms, car X costs 20% more in Italy than in US.

[1]Even if model seems to be different, they represent the basic level of that model in both countries.



(a) Car X sold in US



(b) Car X sold in ITA

Exercise 3

Define and derive the Uncovered Interest Parity (UIP) and explain what it is.

Solution The Uncovered Interest Parity (UIP) defines a relationship between exchange rate and interest rate. This relationship is generated by the need of choosing between domestic or foreign assets.

Investing in 2 countries with different currencies and interest rates should be indifferent, in order to avoid arbitrage opportunities.

Suppose we want to invest €P_t in a bond in Italy. What we would get next year[2] is equal to €$P_t(1+i_t)$. If instead we decide to invest this amount on US bonds, we have to convert our initial amount €P_t on US dollars, i.e. $\$P_t = E_{\$/€}€P_t$. Now, we invest this amount on US bonds and expect to get back $E_{\$/€}€P_t(1+i_t^*)$. This amount at $t+1$ should be converted again in euro, at a rate $E^e_{\$/€,t+1}$. The initial amount invested in Italy and the final one in the US, corrected for national interest rate and exchange rate, must be the same:

$$P_t(1+i_t) = \frac{E_{\$/€}P_t(1+i_t^*)}{E^e_{\$/€,t+1}}$$

[2]Notes on bonds and exercises of section 1 should help.

It follows that, using log properties:

$$(1+i_t) = \frac{E_{\$/€}(1+i_t^*)}{E^e_{\$/€,t+1}}$$
$$\ln(1+i_t) = \ln(1+i_t^*) + \ln\frac{E_{\$/€}}{E^e_{\$/€,t+1}}$$
$$i_t \approx i_t^* - \left(\frac{E^e_{\$/€,t+1} - E_{\$/€}}{E_{\$/€}}\right)$$

and Uncovered Interest Parity is derived. [3]

Ch.18 - The goods market in an open economy

Exercise 1

Consider a European country with open economy, trading with an Asian country. European country is the domestic country in this exercise, has a starting positive trade balance and the government runs a balanced budget.

(a) Derive the equation describing the demand for domestic goods. Outline its components in terms of domestic and foreign demand.

Solution

$$\underbrace{Z}_{\text{Total domestic demand}} = \underbrace{C + I(Y,r) + G}_{\substack{\text{Domestic demand}\\ \text{for domestic goods}}} + \underbrace{X(Y^*,\varepsilon)}_{\substack{\text{Foreign demand}\\ \text{for domestic goods}}} - \frac{1}{\varepsilon}\underbrace{IM(Y,\varepsilon)}_{\substack{\text{Domestic demand}\\ \text{for foreign goods}}}$$

(b) Take the following functional forms for consumption, investment, imports and exports.

[3] $$\frac{E_{\$/€}}{E^e_{\$/€,t+1}} = \left(\frac{E^e_{\$/€,t+1}}{E_{\$/€}}\right)^{-1} = \left(1 + \frac{E^e_{\$/€,t+1} - E_{\$/€}}{E_{\$/€}}\right)^{-1}$$

Derive the new demand for goods.

$$
\begin{aligned}
C &= c_0 + c_1(Y - T) \\
I(Y, r) &= \bar{I} \\
IM(Y, \varepsilon) &= b_1 Y + b_2 \varepsilon \\
X(Y^*, \varepsilon) &= d_1 Y^* - d_2 \varepsilon
\end{aligned}
$$

Solution

$$Z = c_0 + c_1(Y - T) + \bar{I} + G + d_1 Y^* - d_2 \varepsilon - \frac{1}{\varepsilon}(b_1 Y + b_2 \varepsilon)$$

(c) Suppose a pandemic crisis hit the Asian foreign country, whose authorities lockdown its economy and as a result suffer a fall in GDP and income. How this affect the domestic country demand? Show it mathematically and graphically.

Suppose the reduction in foreign GDP is so high that E country experience trade balance.

Solution

$$\frac{\partial Z}{\partial (Y^*)} = d_1 > 0$$

Given a reduction in foreign GDP, domestic country experience a downward shift of the demand curve. Y^* enters only as a constant term, therefore there is no slope change. The initial equilibrium point A (Y=Z) shows that the European country has trade surplus (as outlined above). The new equilibrium A' reflects the new state of the economy in trade balance. The overall level of output for European country is lower (Y'), the drop of foreign demand for domestic goods has shortened production of such goods and income accordingly in the domestic country.

(d) What happens to Net Exports? Show it in the respective graph.

Solution As shown in figure 1, fall in foreign output determines, ceteris paribus, a fall in exports such that the domestic country experience trade balance (from a surplus at the origin). Since exports is one of the 2 components of the NX equation but does not include Y, the final result is a shift downwards of the entire curve.

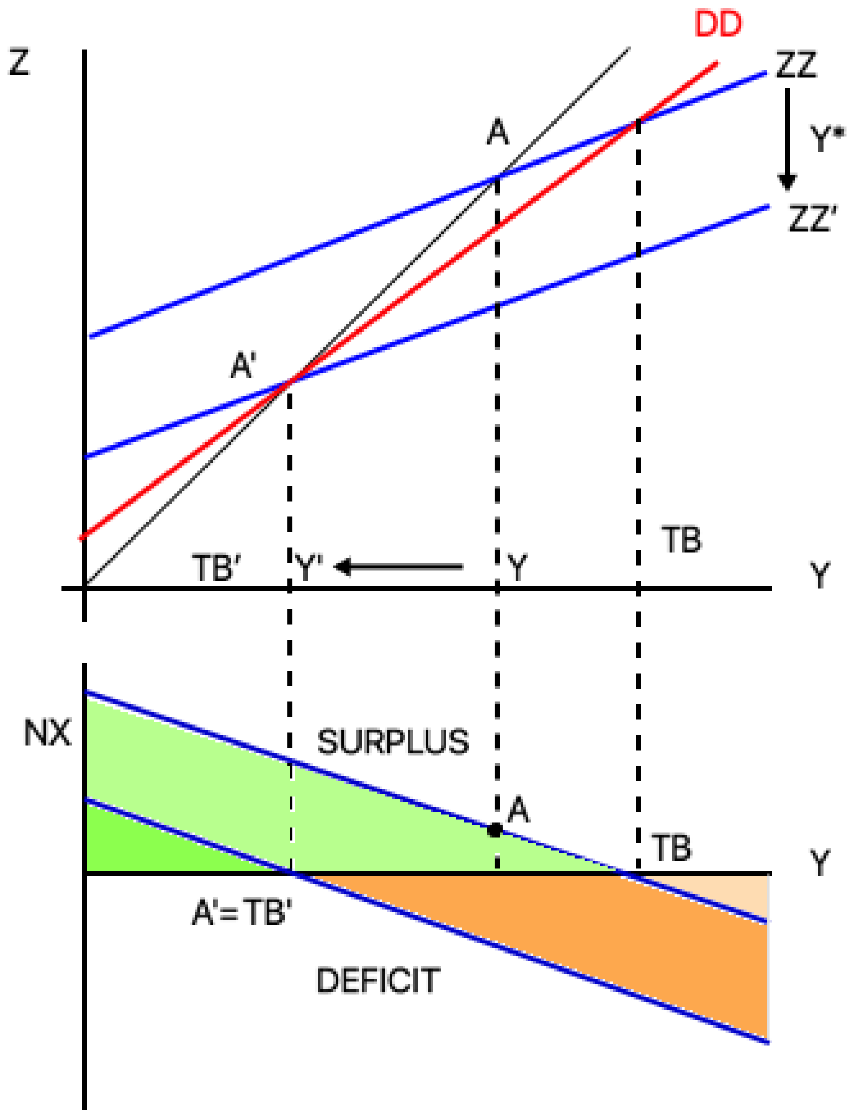


Figure 3: Drop of foreign output Y^* effect on domestic demand.

(e) Derive the equilibrium level of output.

$$Y = c_0 + c_1(Y - T) + \bar{I} + G + d_1 Y^* - d_2\varepsilon - \frac{1}{\varepsilon}(b_1 Y + b_2\varepsilon)$$

$$[1 - c_1 + \frac{b_1}{\varepsilon}]Y = [c_0 - c_1 T + \bar{I} + G + d_1 Y^* - (d_2 + b_2)\varepsilon]$$

$$Y = \underbrace{\left(\frac{1}{1 - c_1 + \frac{b_1}{\varepsilon}}\right)}_{\text{Multiplier}} \underbrace{[c_0 - c_1 T + \bar{I} + G + d_1 Y^* - (d_2 + b_2)\varepsilon]}_{\text{Autonomous spending}}$$

(f) In a second moment the E economy is also hit by pandemics. Propensity to consume drops, due to restrictive measures adopted. Show what happens to the demand curve both mathematically and graphically. How the equilibrium level of output reacts? And the domestic demand for domestic goods?

Solution Effect of propensity to consume change on ZZ:

$$\frac{\partial Z}{\partial(c_1)} = -T + Y > 0$$

The effect of a positive change of the marginal propensity to consume is composed both of a shift of the curve (-T, downward when $\partial c_1 > 0$) and a positive movement of the slope due to effect on Y. In this case we are considering a drop in c_1, hence the signs of the single components are reverted and the overall effect is negative and equal to $-(Y - T)$. As a result, the demand curve ZZ shifts upwards and rotates downwards. What happens to the domestic demand curve (i.e. $C + I + G$)? The same, since the variables affected by the c_1 are entirely embedded in DD. Therefore, shift upwards and down rotation hit the DD curve at the same manner.

What happens instead to trade? The NX curve does not move, since c_1 does not enter the curve directly. What changes, as a result is Y, and the equilibrium level of output in the Net Exports function will shift on the left. The country now has experiencing trade surplus (no more trade balance), since the reduction on the propensity to consume negatively affect demand for domestic goods, but also imports, i.e. demand for foreign goods. Lower imports, without changing the level of exports, determines an overall trade surplus. You can see how the graph changes on the left panel of figure 2.

(g) The government reacts running public deficit, i.e. increasing government spending (no measures on taxes). Show what is the effect of such measure on the equilibrium level of

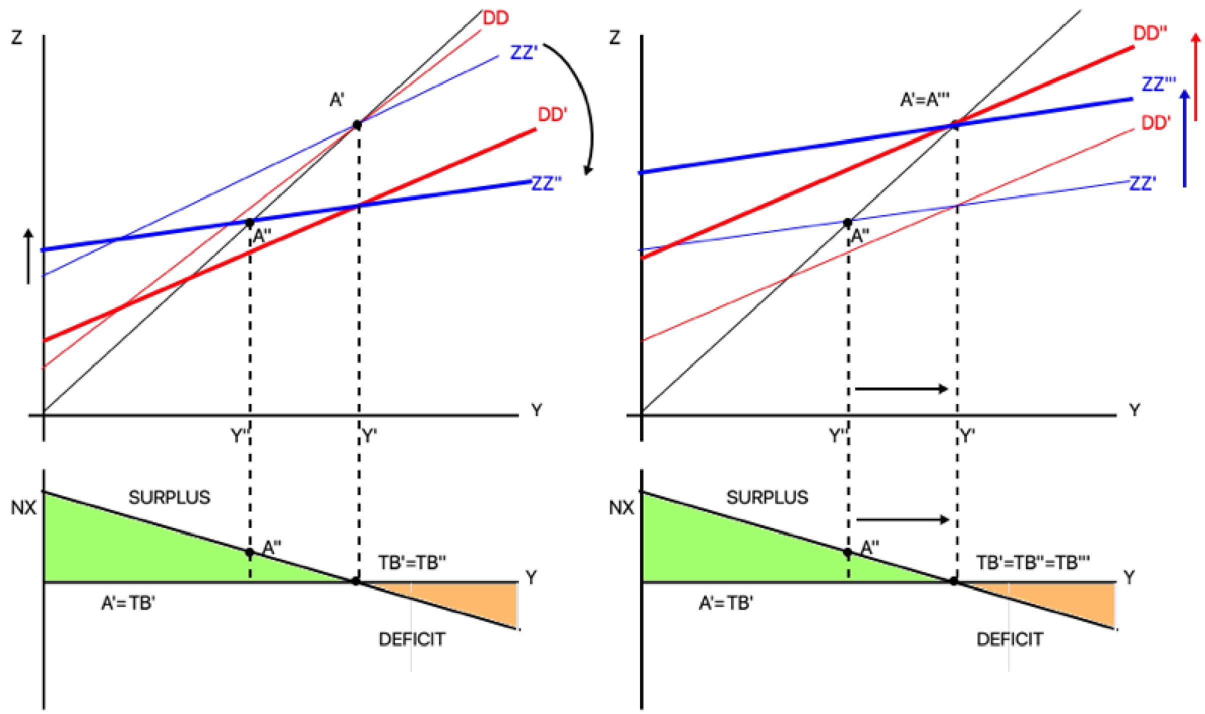


Figure 4: On the left panel graph changes according to a lower c_1. On the right panel graph changes according to higher spending G.

output. Is it possible for the government to reach an equilibrium level of output higher than A' without running a trade deficit?

Solution An increase in public spending provoke a shift upwards of the DD and ZZ curves. Again, G is part of ZZ through DD, therefore changes are equal. Nothing happens to the NX curve, since G does not directly affect exports and imports. Effect on the overall level of output is given by the multiplier and it is positive.

$$\frac{\partial Y}{\partial G} = \frac{1}{1 - c_1 + \frac{b_1}{\varepsilon}} > 0$$

The government can increase G as far as it reaches the previous level of output $Y''' = Y'$ remaining in trade balance. There is no way of reaching an even higher level of output without falling into a trade deficit.

(h) Comment the differences in the multiplier between this economy and a closed economy (with same functional form for interested variables).

Solution

$$\underbrace{\frac{1}{1-c_1+\frac{b_1}{\varepsilon}}}_{\text{Open economy}} < \underbrace{\frac{1}{1-c_1}}_{\text{Closed economy}}$$

The difference between the open and closed economy multiplier is given by the positive amount propensity to import of the domestic country[4] (i.e. $\frac{b_1}{\varepsilon}$). It follows that, an increase in government spending generate a lower increase on the equilibrium level of output in an open economy, since spending is partly absorbed by consumption of foreign goods through imports.

A second concern is to be done on the magnitude of b_1; the fiscal stimulant power of higher spending depends also on how much the country is dependant on imports from abroad. The higher b_1, the tougher for the government to direct public spending on domestic goods. [5]

[4] Corrected for the Real Exchange Rate

[5] There are two interesting boxes to be read in Blanchard, pg. 373-76.