1. **General macro concepts (20 points). Multiple choice: encircle correct answer.**

i. The following data are from an economy with 2 goods:

	2016	2017
Price good *X*	€ 10	€ 10
Price good *Y*	€ 41	€ 50
Quantity good *X*	90	100
Quantity good *Y*	100	90

How much higher is nominal GDP in 2017 than in 2016?

a) 0%
b) 10%
c) 25%
d) None of the above are correct.

ii. Consider an economy with 2 firms. Firm A produces 100 euro worth of output using labor and 50 euro of intermediate inputs. Firm B produces 50 euro of output using only labor, and sells the output to firm A.

a) Value added of the total economy is 100.
b) Value added of firm B is 0, because it uses no intermediate inputs.
c) Value added of firm A is 100.
d) Value added of the total economy is 150.

iii. A group of supporters from the Netherlands goes to Korea to cheer at the Paralympics. . Which statement(s) is(are) true?

a) ***This increases GDP of the Korea and decrease net exports of the Netherlands****.*
b) This decreases GDP of the Korea and increases consumption of the Netherlands.
c) This increases consumption of the Korea, but decreases net exports of Korea.
d) All of the above are correct.

iv. Assume that money supply increases 4%, GDP increases 1%, and the velocity of money increases 2%. What is the inflation rate?

a) 8%
b) 5%
c) 4%
d) -2%

v. What instrument can the Central Bank use to control the money supply?

a) The reserve ratio
b) The inflation rate
c) The currency-deposit ratio
d) None of the above

vi. An economy has a monetary base of 1 bln euro. Calculate the money supply in case all money is held as demand deposits and banks hold 10 percent of deposits as reserves.

a) 10 bln euro
b) 20 bln euro
c) 0.8 bln euro
d) 1.25 bln euro

2. **A Classical economy (20 points).** An economy, without money, is described with the following accounting rules and behavioral equations:

Y = C + I + G + X - M, Y = 1000, G=500,
C(Y-T) = 100 + 2/3 (Y-T), T=400
I(r) = 300 – 25r, X=400, M=600

where: $Y =$ income/production; $G =$ government spending; $T =$ taxes; $C =$ consumption; $I =$ investment; $X =$ exports; $M = imports$; $r =$ domestic interest rate; [provide calculations, as well as numerical answers].

a. Compute consumption, public savings, the trade deficit, and net capital inflow.

- $S_{private} = Y - T - C = Y - T - (100 + 2/3\ (Y - T)) = 1000 - 400 - 500 = \mathbf{100}$, Consumption = 1000-400-100=500
- $S_{public} = T - G = 400 - 500 = \mathbf{-100}$
- $Trade\ deficit = M - X = 200$,
- Capital inflow equals -net exports. Hence, $|400 - 600| = \mathbf{200}$

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b. What variable adjusts to bring savings and investment in balance? What is its equilibrium value?

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r interest rate; $Y = 100 + \frac{2}{3}(Y - T) + 300 - 25r + G + X - M$

$$r = \frac{1}{25}\left[\left(100 + \frac{2}{3}(Y - T) + 300 + G + X - M\right) - Y\right]$$

$$r = \frac{1}{25}\left[\left(100 + \frac{2}{3}(1000 - 400) + 300 + 500 + 400 - 600\right) - 1000\right] = \frac{100}{25} = \mathbf{4}$$

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c. If output is allowed to adjust but the interest rate does not change, compute what happens to income when autonomous investments falls such that investment demand is described by
$I_{new}(r) = 250 - 25r$. (Use the Keynesian multiplier.)

$$Y = 100 + \frac{2}{3}(Y - T) + (250 - 25r) + G + X - M \rightarrow \frac{1}{3}Y = 283.33$$

or $\Delta Y = \frac{1}{1 - mpc} * -100 = \frac{1}{.333} * -100 = \mathbf{-150}$, so Y=850

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d. Given the change to investment in c. above, compute what happens to private and public savings.

Savings with new Y:

$S_{private} = Y - T - C = Y - T - \left(100 + \frac{2}{3}(Y - T)\right) = 850 - 400 - 400 = \mathbf{50}$

$S_{public} = T - G = 400 - 500 = \mathbf{-100}$

Hence, private saving decreases with **50**, public savings **do not change**.

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3. **Economic Growth (20 points).** Use the Solow model for these questions.

a. Write down the equation determining the dynamics of the stock of capital per worker in the Solow model. Which flows are equal in the steady state? If production is given by: $Y = K^{0.5}L^{0.5}$, solve for the steady state capital (K) per worker (L), that is k=K/L, in terms of the exogenous model parameters. **(5 points: 2+1+2)**

$\Delta k = sy - (\delta+n)\,k$, where k=K/L, y=Y/L and exogenous parameters savings rate s, depreciation rate δ and population growth rate n. In terms of K and Y: $\Delta K = sY - \delta K$

In steady state $\Delta k=0$ or $sy = (\delta+n)\,k$: per worker investment or savings equals required replacement due to depreciation and population growth.

$s\,k^{0.5} = (\delta+n)\,k \Rightarrow k = (s/(\delta+n))^2$

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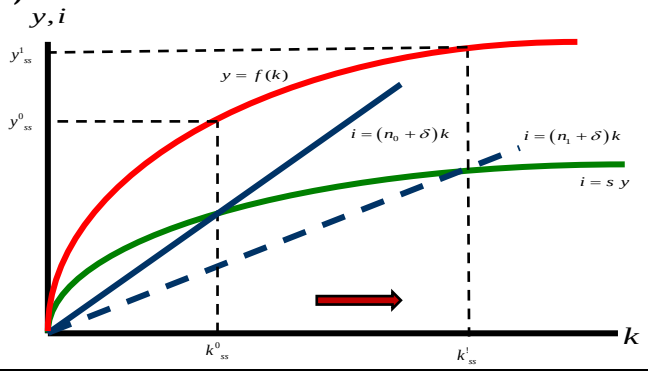
b. Show in the graph and describe what happens to steady state capital per worker and income per worker when the rate of population growth falls in the Solow model. (**5 points: 3 +2)**



At lower population growth n ($n_1<n_0$), the capital requirement line ($i = (n+\delta)k$) rotates down. It crosses the savings-investment curve ($i = s\,y$) at higher capital per worker ($k^1>k^0$) and also income per worker becomes higher ($k^1>k^0$).

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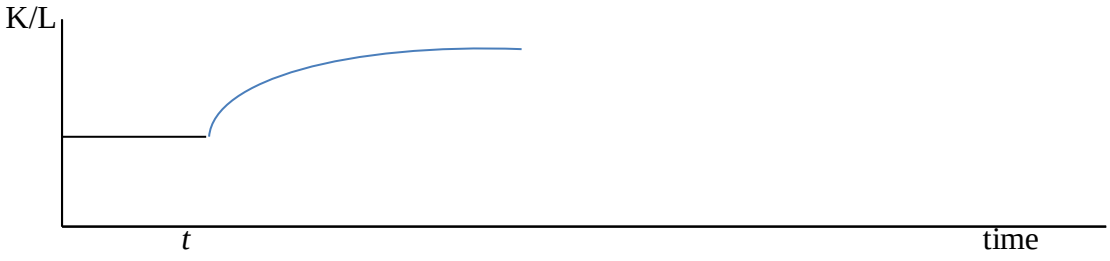
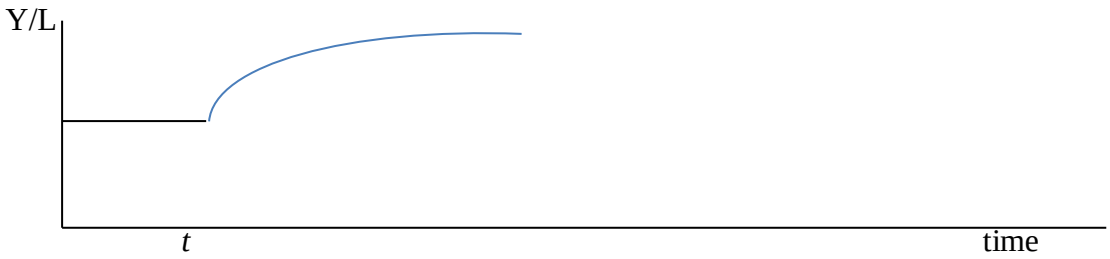
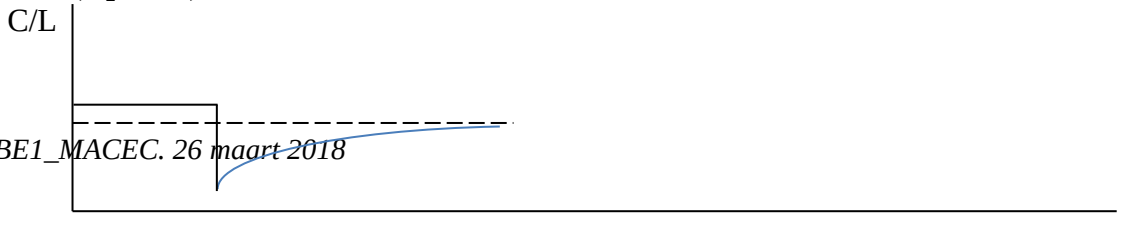
c. In the time series graphs, below, draw what happens to capital and output per worker (K/L and Y/L, respectively), when the savings rate is increased at time *t*. **(5 points)**



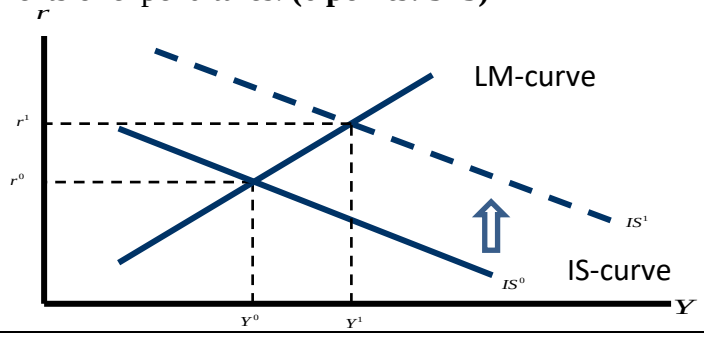


d. Assume that, initially, the marginal product of capital is smaller than the depreciation rate. Draw the time path of consumption per worker (C/L) when the savings rate is increased at time *t*. **(5 points)**



4. IS-LM and Mundell-Fleming Model (20 points).

a. Draw the IS- and LM-curves (for a closed economy) in the graph below. (Do not forget to label the axes.) Show what happens to the economy in the short run following a increase in Government spending. Describe what happens to other components of expenditures. **(6 points: 3+3)**

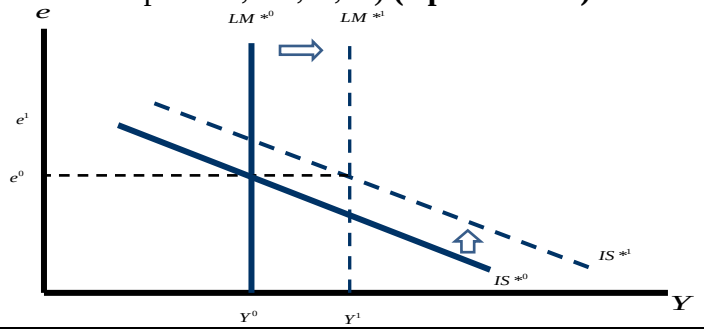


G+ =>
Y+; C+ planned expenditure go up=>
IS curve shifts upwards & money demand L^D+
=> because money supply M/P is fixed, interest rate must increase to restore LM
In new equilibrium: Y+; r+; C+; I−

b. For the following shocks to the EU economy (assume the EU is a closed economy), show with a '+' , '-' or '=' what happens to the interest rate (r) and income (Y) in the short run. **(8 points: 2+2+2+2)**

	r	***Y***
i. Taxes on German and Italian cars decrease.	+	+
ii. The Central Bank decreases the money supply through sales of govt bonds.	+	-
iii. Households foresee better times ahead and increase their consumption.	+	+
iv. A fear of increased financial volatility causes people to keep more wealth in the form of money.	+	-

c. Consider a small open economy with a fixed exchange rate. Draw the IS* and LM* curves (label the axes) and show the effect of a decrease in taxes. Describe what happens to expenditures Y, its components, C, I, NX and to interest rate 'r' and exchange rate 'e'. (use + ,-, =. For example: Y=, C+, I-, ...) **(6 points: 3+3)**



T− => Y+; C+ planned expenditure go up=> IS* curve shifts upwards
=> exchange rate appreciates $e^1 > e^0$
=> to keep the fixed exchange rate $e=e^0$ the Central Bank must increase money supply M/P, LM* shifts to the right until the new equilibrium is reached
In new equilibrium: Y+; C+; r=; I=; e=; NX=

5. **AS-AD and Phillips-Curve (20 points).**

a. Does the AS curve derived under the assumption of sticky prices slope upwards? Why?

Yes. In the sticky price model, at each point in time only a fraction of firms are able to change their price. If AD rises, firms that can change price do not adjust output but raise prices. Other firms raise output to meet demand. If AD remains high, next period other firms raise Prices and bring output back to natural level. Over time, prices rise and output stays at natural rate. But initially, the increase in AD increases average prices and total output.

b. Write down the relationship between the price level and output in the sticky wage model of aggregate supply. Describe what happens to real wages if the economy goes into a recession. Is this prediction supported by empirical evidence?

$Y = Y_n + b(P-P^e)$. In sticky wage model nominal wages are set in advance, $W = \omega P^e$ based on desired real wage and expected future prices. When economy goes into a recession, output is below Y_n so prices start dropping. Given sticky nominal wage, real wages go up, so firms reduce labor (to equate wage and marginal product of labor.) So, positive relation between output and prices. The sticky wage model predicts counter-cyclical real wages, counter to real world data.

c. Write down the Phillips curve and describe the trade-off that the Phillips curve implies. What happens to the Phillips curve, and the position of the economy on a Phillips curve in the short and long run after the Central Bank increases the growth rate of the money supply? (state which assumption you make about price expectations)

$\pi = \pi^e - b(u - u_n) + v$ inflation depends expected inflation, unemployment minus the natural rate of unemployment and a supply shock. Under rational expectations, if CB increases growth rate of money, people will expect higher inflation. With a rise in expected inflation, Phillips curve shifts up and inflation goes up. Under adaptive expectations, with increased growth on money, LM curve shifts Right, output rises, unemployment down. Given infl expectations, inflation increases. This will increase infl expectations next period and PC shifts up. This happens until eventually we have same inflation as under RE, and u back to natural rate.