

Question 1 (20%)

Explain briefly the following terms

- a) Multiplier effect
 - b) Real interest rate
 - c) Trade balance
 - d) Real exchange rate
 - e) Steady state level of production per worker
 - f) Technological progress
- a) *In economics, the multiplier effect is about the dynamics of production. The most important effect is via consumption. When production increases, so do the income in the economy. Some of the higher income is used for consumption, determined by the marginal propensity to consume. The extra consumption must be produced, and it therefore increases production. Which again increases consumption and production. It is a converging process, which gives a higher increase in production than the initial rise. It is also possible to say something about factors determining the size of the multiplier effect, such as investment and international trade.*
- b) *The interest rate is the price of money. It is what you get if you place the value in the alternative to money (bonds). However, what you can buy for the value of the bonds in the future depends on what happens with the price level. The real interest rate is the (nominal) interest rate minus the inflation.*
- c) *Trade between countries has two directions. It is products out of the country – export – and products into the country – import. The trade balance is the difference in the value of export and import, measured at a common value. The trade balance in common value can be expressed in different ways. The most usual way is to measure import in the value of domestically produced goods. This is a correction based on the exchange rate and the difference in price levels. It might be useful to be specific, writing the trade balance as $NX = X - IM/\epsilon$, where NX is the trade balance, X is export, IM is import and $\epsilon = E \cdot P/P^*$, where E is the exchange rate and P and P^* is the domestic and foreign price level, respectively.*
- d) *It is the relative price of domestic goods in terms of foreign goods. It is possible to answer this question in relation to c). The real exchange rate takes differences in price levels between countries into account. The nominal exchange rate trade one currency for another, without saying anything about how much can be bought for each unit of a currency. It might be useful to be specific, writing the real exchange rate as in c).*
- e) *In an economy without technological progress, it is the state of the economy where the production per worker is constant and does not change. In an economy with technological progress, it is the state of the economy where the production per efficient worker is constant and does not change. Constancy requires an equilibrium where the saving rate is constant.*
- f) *Technological progress is in economics defined as changes in production technology such that more can be produced with the same amount of input in production (labor and capital). It is an improvement in the state of technology.*

Question 2 (30 %)

Several countries came out of the pandemic with a low unemployment rate and a substantially higher public debt than prior to the pandemic. In one country, the Ministry of Finance proposes to increase taxes in order to reduce the public debt.

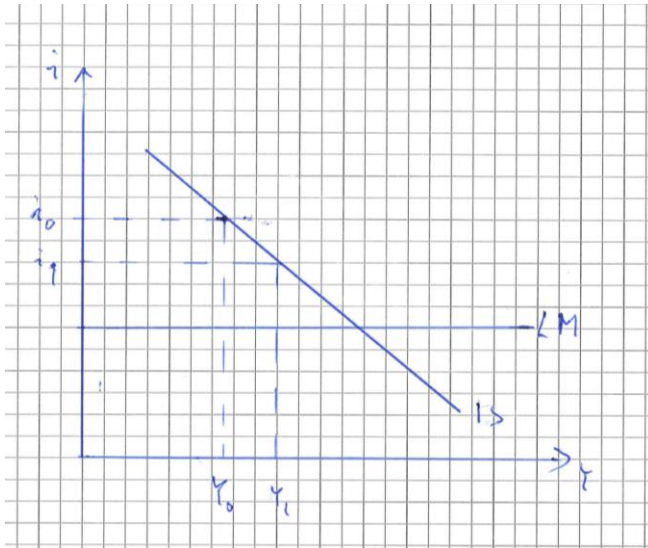
- a) Derive the IS-LM model for a closed economy.
- b) Consider the interest rate as fixed and discuss the effect of the proposed policy on production, private consumption and private investments.

a) It is expected that the goods market is discussed. It can be done by use of equations, or by verbal reasoning. The discussion is expected to include

- *The equilibrium condition. This states that equality between production and total demand in the economy. The demand (Z) in a closed economy consists of private consumption (C), private investment (I), and government spending (G), which must be equal to the production (Y). In form of an equation, $Y = Z = C + I + G$.*
- *The consumption function. Total consumption in an economy depends on the private disposable income in the economy, which is production less taxes. In form of an equation, $C = C(Y - T)$, where T is taxes.*
- *The investment function. Total investment in an economy depends on the level of production and the interest rate. Explain why, and it is in particular important to explain that higher interest rate makes investments more costly; it is a negative relationship between the interest rate and investment.*

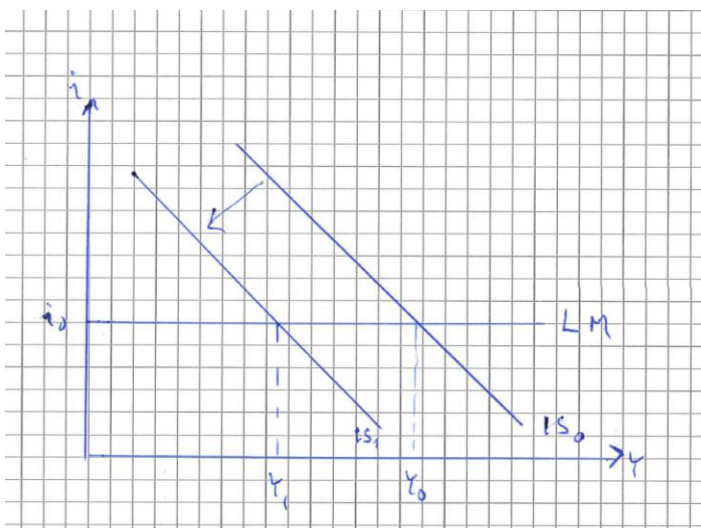
These relationships is summarized by the IS-curve. The essential part is to draw the IS-curve and explain why it has a negative slope in the $Y - i$ space as shown in the figure below. A lower interest rate, say a reduction from i_0 to i_1 in the figure, increases private investment, which increases production and induces a multiplier effect. The total effect on production is an increase from Y_0 to Y_1 . The IS-curve can be formulated as an equation based on the equations above, it can be derived from a diagram of the goods market, or it might be well verbally explained.

Next, it is necessary to discuss the money market. It is valuable to discuss the money markets in some length to show the relationship between the demand for money, the supply of money and the interest rate. From such a discussion it follows that the central bank can determine a specific interest rate by adjusting the money supply such that the money market is in equilibrium to the pre-determined interest rate. The LM curve below describes such a situation. The central bank has determined the interest rate. Because the interest rate is a policy variable, it will not change based on changes in the private part of the economy but only by a policy decision. Thus, the LM curve is flat in the figure.



b) In the IS-LM model, the only effect of taxes is on disposable income. It is useful to refer back to the consumption function discussed in a). Increased taxes reduce disposable income, and thus private consumption. For given values of all other variables in the model, the demand gets smaller. The implication is that the IS-curve shifts inward as shown in the figure. This shift includes the multiplier effect. The equilibrium changes for $Y = Y_0$ and $i = i_0$ to $Y = Y_1$ and $i = i_0$. The effects of the policy are

- reduced production from Y_0 to Y_1 . This follows directly from the figure.
- reduced private consumption. There is a first direct effect of higher taxes. The reduction in production also reduces disposable income and thus private consumption. The effect on private consumption is larger than the initial effect of higher taxes.
- reduced private investment. It is common to assume that private investment depends on the interest rate and on the total production in the economy. In this case, the investment will decline because production declines. This effect will be a part of the multiplier effect. It is also possible to simplify the model setup in a) such that investment only depends on the interest rate. Then there will be no effect on private investment because the interest rate is unchanged.



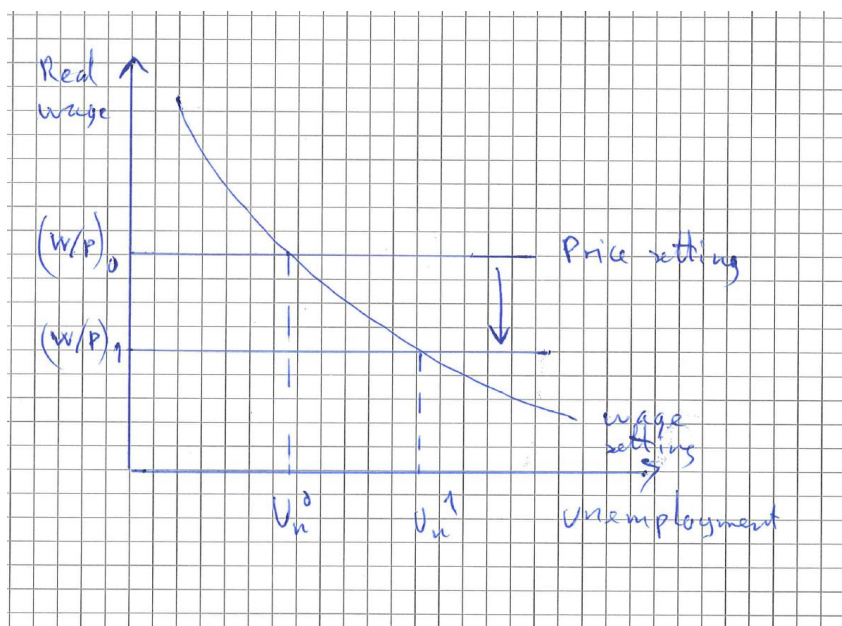
Question 3 (50%)

Many countries had an increasing inflation rate in 2022. Consider the case that the underlying reason is a higher mark-up of the price over the wage cost.

- Use a model for wage setting and price setting to discuss the effect of a higher mark-up on real wages and unemployment.
- Present a relationship between inflation and unemployment and discuss the impact of a higher mark-up on the relationship.
- Define the terms “natural rate of unemployment” and “natural rate of production”.

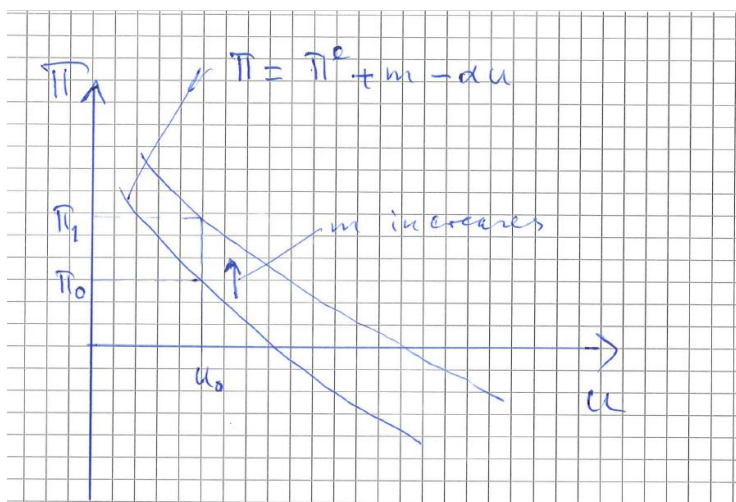
a) A model for wage- and price setting must be developed. Some discussion of why wages are negatively related to unemployment is expected. It might be via market forces, collective bargaining or efficiency wages. Workers care about how much they can expect to be able to buy for their wage, which is the expected real wage. Regarding price setting, it is expected that the simple framework in the text book is followed since the question ask specifically about the mark-up of the price. Because of lack of competition, and that production might include some non-wage fixed costs, the price will be higher than simply covering the wage cost. The price is expected to be assumed to be a fixed mark-up over the wage. This discussion is summarized in the figure below, where the initial stable equilibrium is the initial natural rate of unemployment (u_n^0). It can also be specified in terms of equations, where the wage setting is $W = P^e * F(u)$ and the price setting is $P = (1 + m) * W$, where W is the wage, P is the price, P^e is the expected price, u is unemployment, F is a symbol for a function and m is the mark-up.

Higher mark-up implies a higher price for a given wage. The real wage (W/P) declines. The price setting curve shifts downward, as shown in the figure. Unemployment increases from u_n^0 to u_n^1 and the real wages decrease from $(W/P)_0$ to $(W/P)_1$. Unemployment increases in order for the workers to accept the lower real wage.



b) The relationship between inflation and unemployment is denoted the Phillips curve. Lower unemployment increases the wage via the wage setting discussed in a), which in turn increases the price via the price setting discussed in a). There is a negative relationship. This is shown in the figure below. It is an advantage to develop this formally. Inflation is the percentage change in the price, that is the change compared to the initial situation. Formally, the inflation is given by $\pi = (P_t - P_{t-1})/P_{t-1}$, where t is a time index. Expected inflation has the same expression except that it is in terms of P^e instead of P_t . The wage setting equation can be written such that it is linear in real terms, that is $W = P^e * (1 - \alpha * u)$, where α is a parameter. Inserted into the price setting equation above gives $P = (1 + m) * W = (1 + m) * P^e * (1 - \alpha u)$. Combining the equations give $(1 + \pi) = (1 + m) * (1 + \pi^e) * (1 - \alpha u) \approx 1 + \pi^e + m - \alpha u$.

It follows from the equation that increased m increases π , for given unemployment, in order for the equation to hold. This is the same mechanism as shown in the figure in a). This is an upward shift in the Philips curve, as shown in the figure. For unemployment equal to u_0 , the inflation increases from π_0 to π_1 when the mark-up m increases.



c) The natural rate of unemployment is defined as the unemployment rate at which the price and wage setting are consistent. This implies that inflation is constant. Since higher production requires higher employment, which is lower unemployment, the natural rate of production can be defined similarly. The natural rate of production is the production level that follows from the natural level of unemployment. This might be expressed in terms of an equation. Setting $\pi = \pi^e$ in the equation above, it follows that the natural level of unemployment is $u_n = m/\alpha$.

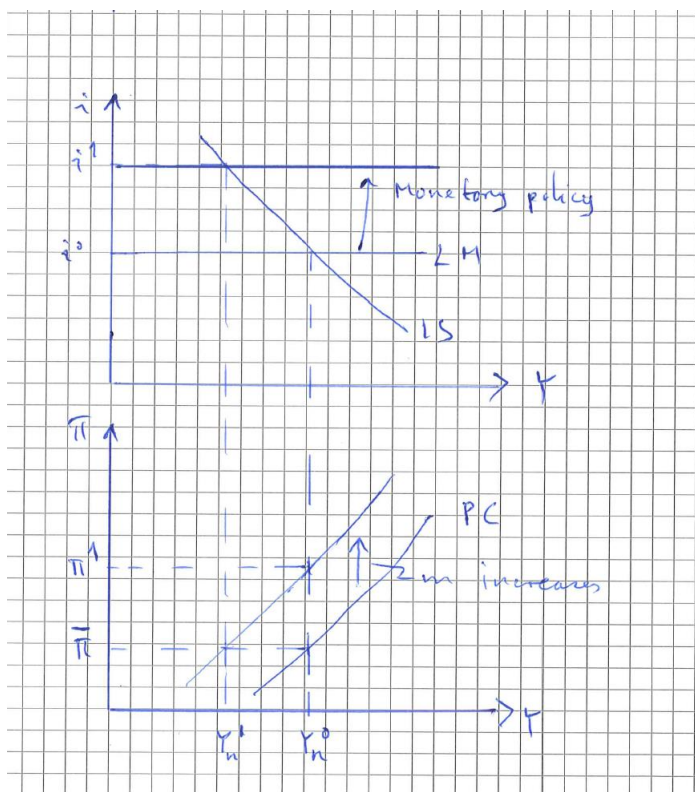
In many countries, the mandate of the central bank is stable inflation with an explicit inflation rate target. Consider the situation where the expected inflation rate in the economy is equal to the inflation rate target of the central bank, and the central bank changes the interest rate in order to achieve an inflation rate equal to the target.

- d) Use a macroeconomic model to discuss the effect of a higher mark-up on production, private consumption and private investment.
- e) How is the answer in d) modified if the government increases taxes?

d) The question says nothing about international relations. It is therefore expected to use a closed economy model. A sufficient model combines the IS-LM model developed in Question 2 and the Philips curve (PC) developed in a) – c).

PC must be expressed in terms of production. This is done in the figure below. With higher production, employment is higher and unemployment is lower. Lower unemployment increases the wage from the wage-setting model, which increases the price from the price-setting equation. A higher price level implies higher inflation as developed in b). Thus, there is a positive relationship between production and inflation, as shown by the PC-curve in the figure. PC might also be expressed in terms of an equation. It is then necessary to specify a relation between unemployment and production. If $Y = A * N$, where A is a constant and N is employment, it follows that $Y = A * (1 - u) * L$, where L is the labor force. Inserted into the relationship above, $(1 + \pi = 1 + \pi^e + m - \alpha u)$, it follows that $(\pi - \pi^e) = \frac{\alpha}{AL}(Y - Y_n)$, where $Y_n = A * (1 - u_n) * L = A * L * (1 - m/\alpha)$.

A higher mark-up shifts PC upwards as shown in b). In the figure below, it is assumed that the initial inflation was equal to the central bank target $\bar{\pi}$, with the associated $Y = Y_n^0$. The inflation increases from $\bar{\pi}$ to π_1 . Because the mandate of the central bank is an inflation rate target, the central bank must react by using monetary policy. Inflation can be reduced by a reduction in production, which is achieved by an increased interest rate. The central bank increases the interest rate from i^0 to i^1 , which shifts the LM curve upwards. The figure is drawn as the new equilibrium where the inflation rate is back to its target $\bar{\pi}$. The new natural rate of production is Y_n^1 . Lower production implies lower private consumption, because of lower disposable income, and lower private investment, because of higher interest rate and lower production. It is possible to refer to Question 2 for mechanisms. The dynamics from the situation with $\pi = \pi_1$ and $Y = Y_n^0$ to $\pi = \bar{\pi}$ and $Y = Y_n^1$ can be discussed.



e) This is presented in the figure below. It is useful to refer back to Question 2 regarding the shift in the IS-curve. The interest rate will be lower than in d). How much lower depends on the size of the reduction in the taxes, that is, the size of the shift in the IS-curve. In principle, the interest rate might be lower than i^0 if the change in taxes is large. Some discussion of why the contradictory monetary policy become smaller in this case than in d) is valuable. It is also valuable to show that the effect on consumption and investment will be different than in d).

