Macroeconomics A
Solution to practice exam 2014
(based on the exam spring semester 2011)

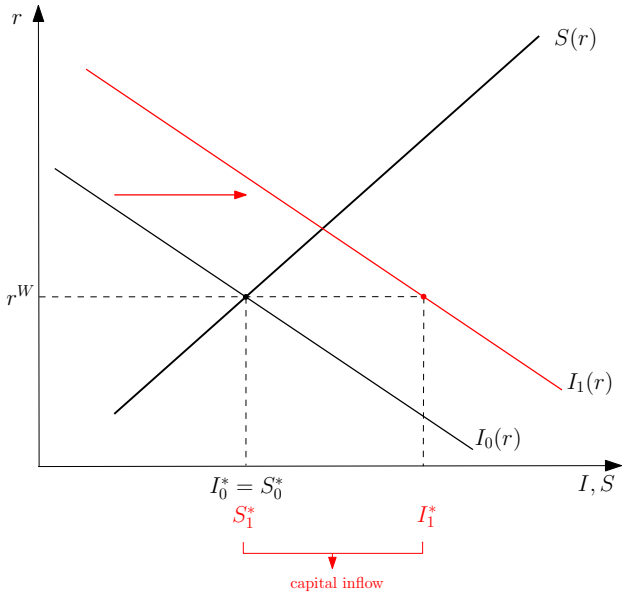
Question 1 (20 points)

Consider a developing country that improves the legal protection of investors and the enforcement of property rights. Use the small open economy model to answer the following questions.

Part i) *(8 points)*

What happens to investment, saving, and capital flows in this country? Use a diagram to support your answer.

- improving the legal protection and enforcement of property rights reduces uncertainty about investment projects
- (profitability of investment projects increases due to a decline in risk premium)
- $I(r)$ curve shifts to the right
- savings curve is not affected
- definition of variables:
  r^W: world real interest rate
  I^*: equilibrium volume of investment
  S^*: equilibrium volume of saving

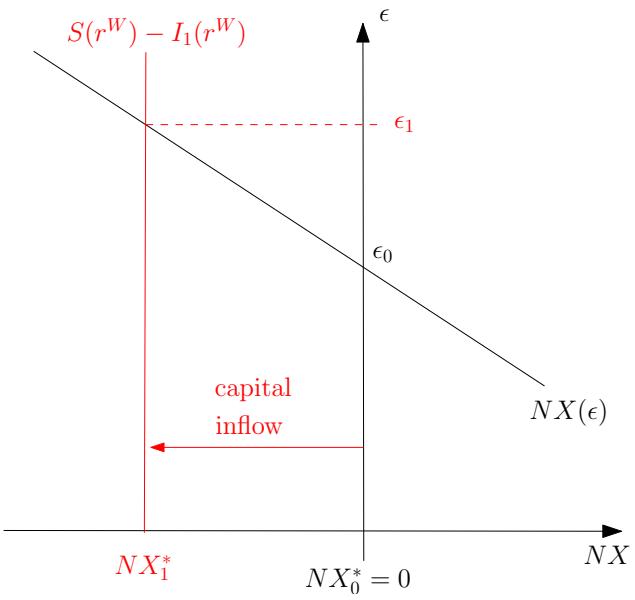


- in a small open economy the equilibrium volumes of saving and investment are determined by the world interest rate: S^* const., I^* increases
- thus, the shift of the investment curve caused by the reforms leads to capital inflows at the world interest rate that finance domestic investment projects.

Part ii) *(8 points)*

Explain how and why the real exchange rate and the trade balance are affected. Use a diagram to support your answer.

- the increase in investment increases capital inflows. Thus, the $S - I$ curve shifts to the left
- the net export curve is not affected
- the accounting identity requires $NX \equiv S - I$. Therefore, net exports have to adjust
- definition of variables:
  ϵ: real exchange rate
  NX^*: equilibrium volume of net exports



- the rise in investment increases the demand of foreigners for domestic currency
- this leads to an appreciation of the domestic currency ($\epsilon_0 \nearrow \epsilon_1$). Net exports decrease $\Rightarrow$ trade deficit

Part iii) *(4 points)*

Suppose that the country has pegged its currency to the dollar so that the nominal exchange rate cannot change. What happens to inflation in this country if inflation in the U.S. (rest of the world) is zero?

- the real exchange rate is defined by

$$\epsilon = e \cdot \frac{P}{P^*}$$

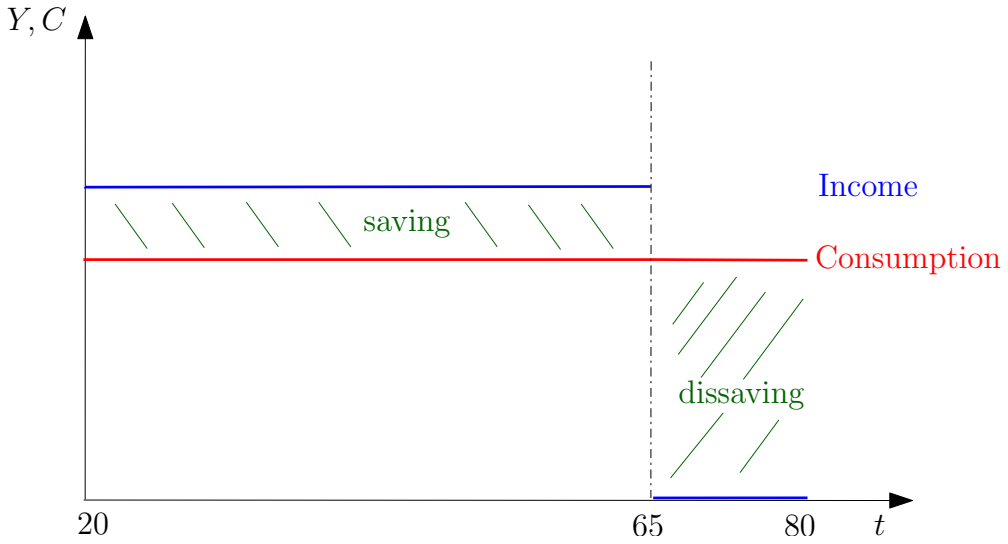
  where e: nominal exchange rate, P: price level of domestic country, P^*: price level of foreign country
- fixed exchange rate regime: e is constant
- inflation in U.S. $\pi^* = 0 \Rightarrow P^*$ constant
- Thus $\epsilon \uparrow \Rightarrow P \uparrow$, i.e. inflation in the developing country goes up (temporarily)

Question 2 (20 points)

Demographers predict that the fraction of the population that is elderly will increase in Germany over the next 20 years. Assume that the population consists of workers and elderly (retired) individuals.

Part i) *(8 points)*

NOT APPLICABLE IN CLASS OF 2014! **According to the life-cycle model, what is the effect on the national saving rate? Provide a life-cycle diagram to support your answer.**



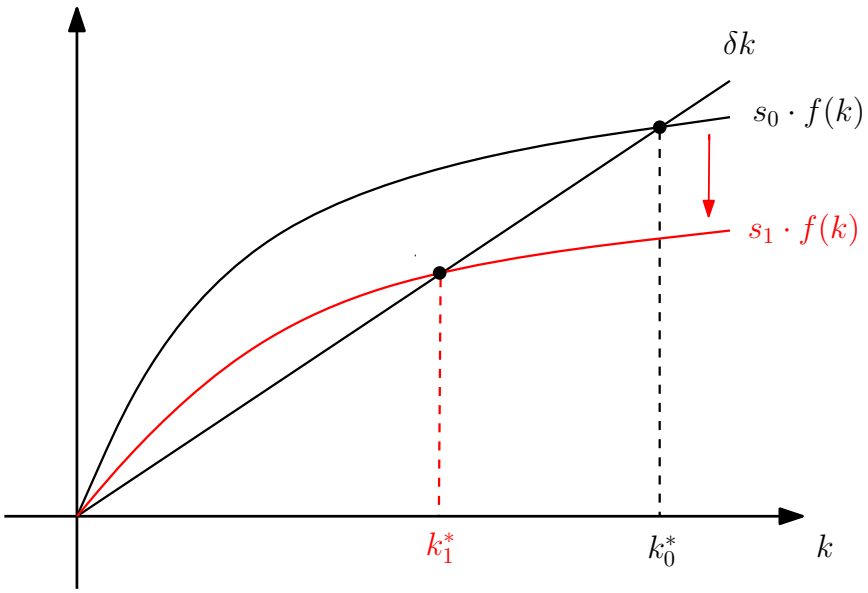
- fraction of retired agents increases
- fraction of people that live out of their savings increases whereas fraction of agents that saves decreases
- private saving and thus national saving decrease
- national saving rate s decreases

Part ii) *(8 points)*

Assume that the effect of i) takes place instantaneously. What is the effect on the steady state values of capital and output per worker according to the Solow growth model? Use a diagram to support your answer.

- definition of variables:
  $k = \frac{K}{L}$ capital per worker
  $y = \frac{Y}{L}$ output per worker
  $f(k)$ production function in intensive form
  s national savings rate
  δ depreciation rate

- decrease in the national savings rate means that the savings curve moves downward
- Solow diagram implies a lower steady state capital per worker ($k_0^* \searrow k_1^*$)
- output per worker $y_1^* = f(k_1^*)$ is lower than y_0^* due to positive marginal returns



Part iii) *(4 points)*

Name two government policies that could counteract the effect on the national savings rate so that it would remain constant. Provide a brief explanation.

Note: Here are just a few examples:

- *NOT APPLICABLE IN CLASS OF 2014!* Increase retirement age: this directly counteracts the reason for the falling savings rate.
- *NOT APPLICABLE IN CLASS OF 2014!* Try to increase young population by allowing more immigrants and by implementing family-friendly environment.
- Reduce government spending: $G \downarrow \Rightarrow S^g \uparrow \Rightarrow$ savings rate $s \uparrow$
- Tax reductions for old age savings: same mechanism: $s \uparrow$
- investment subsidies (e.g. financed by lump-sum taxes): profitability increases, investors can pay higher interest rates, private saving increases, $s \uparrow$

Question 3 (20 points)

Part i) *(3 points)*

State the two intermediate targets and the three final targets of monetary policy. Which of the three final targets is the main target for most central banks?

intermediate targets:

1. money supply
2. interest rates

final targets:

1. inflation
2. output
3. employment

Most central banks focus on inflation (*inflation-targeting*)

Part ii) *(8 points)*

Use the quantity theory of money and the quantity equation to derive analytically the effect of increasing the money growth rate from 2 percent to 3 percent. State your assumptions clearly.
definition of variables:

- M money supply
- V velocity
- P price level
- Y real output

quantity equation:

- in levels: $M \cdot V = P \cdot Y$
- in growth rates: $\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$

quantity theory: quantity equation + two assumptions:

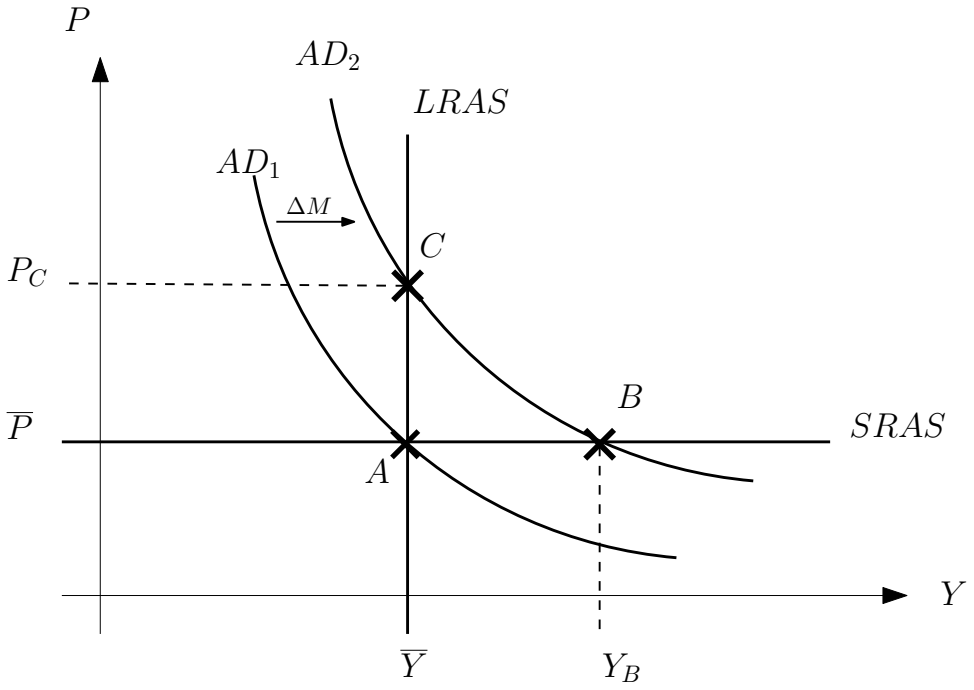
1. $\frac{\Delta V}{V} = 0$ because V constant
2. $\frac{\Delta Y}{Y}$ exogenously determined (by the real economy)

$\Rightarrow$ increasing $\frac{\Delta M}{M}$ from 2 to 3 percent implies $\frac{\Delta P}{P}$ increases by 1 percentage point. *(Note:* $\frac{\Delta Y}{Y}$ *can be different from 0)*
no effect on output growth $\frac{\Delta Y}{Y}$

Part iii) *(9 points)*

Use the AD-AS framework to discuss the short-run and long-run effects of an increase in money supply on output and the price level. Provide a diagram to support your answer.

- Definition of variables
  - $\Delta M > 0$: expansion in money supply
  - Y: aggregate output
  - P: aggregate price level
  - AD: aggregate demand
  - $LRAS$, $SRAS$: long- / short-run aggregate supply
  - A: initial situation (initial long-run equilibrium)
  - B: short-run equilibrium
  - C: final long-run equilibrium
- $\Delta M > 0 \Rightarrow$ AD curve shifts to the right because of the real money balance effect (consumers have more purchasing power to spend, because prices fixed at $\bar{P}$ in the short-run $\Rightarrow$ they will demand more)



- short-run effect (point B):
  prices are sticky ($P_B = P_A = \bar{P}$), production expands to satisfy demand: $Y \uparrow$ from $\bar{Y}$ to Y_B
- long-run effect (point C):
  price level is higher than initially ($P_C > P_A$), production level is the same as in the initial long-run equilibrium, namely potential output $\bar{Y}$

Question 4 (20 points)

The following questions refer to the classical model of the labor market.

Part i) *(4 points)*

Derive the first-order conditions (FOCs) associated with the firm's maximization problem for a general neoclassical production function.

$$\pi = pF(K, N) - w \cdot N - r \cdot K$$

- Definition of variables

$$\begin{aligned} \pi &: \text{profits,} \\ p &: \text{price of good} \\ w &: \text{wage} \\ r &: \text{rental rate of capital (interest rate)} \\ N &: \text{(employed) workers} \\ K &: \text{capital} \end{aligned}$$

- Let $p = 1$ *(normalisation)*
- $\max_{K,N} \pi$
- FOCs:

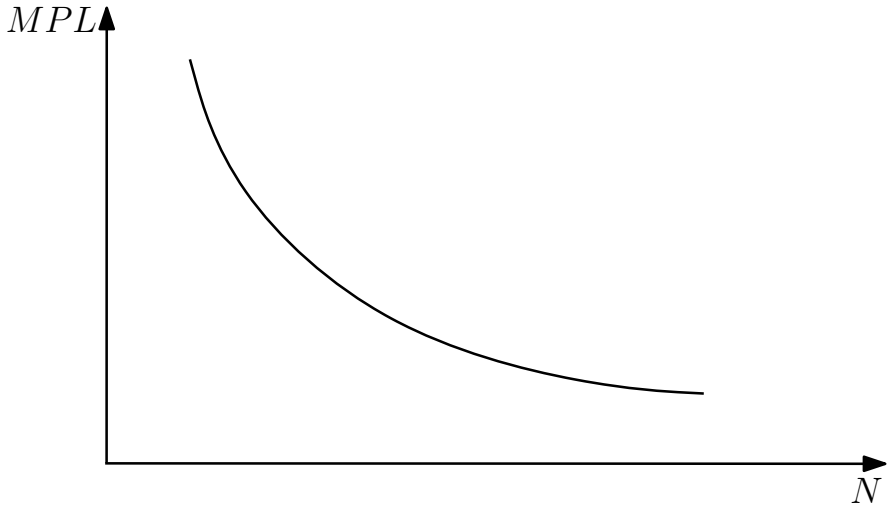
$$\begin{aligned} \frac{\partial \pi}{\partial K} &= \frac{\partial F(K,N)}{\partial K} - r = 0 \\ \frac{\partial \pi}{\partial N} &= \frac{\partial F(K,N)}{\partial N} - w = 0 \\ \\ \frac{\partial F(K,N)}{\partial K} &= r \;\Leftrightarrow\; MPK = r \\ \frac{\partial F(K,N)}{\partial N} &= w \;\Leftrightarrow\; MPL = w \end{aligned}$$

- MPL: marginal product of labor
- MPK: marginal product of capital

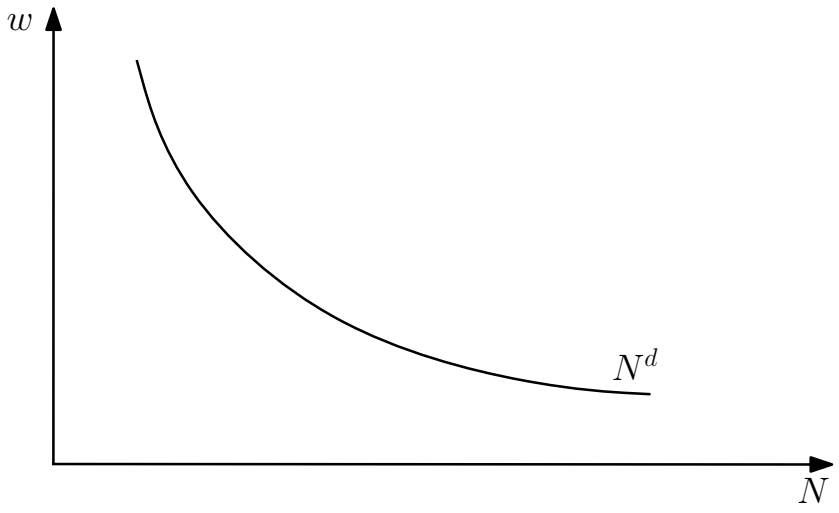
Part ii) *(5 points)*

Use the FOCs to derive graphically the labor demand function.

- Assumption on the production function: positive, diminishing MPL



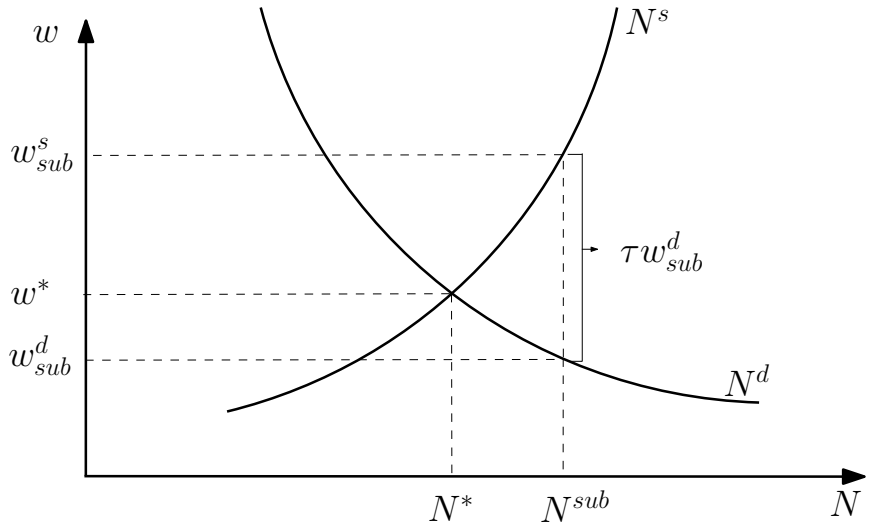
- Using the FOCs, we can now say: $MPL(N) = w$
- This implicitly defines the labor demand function $N^d(w)$



Part iii) *(6 points)*

Discuss graphically how a proportional wage subsidy to the firm will affect equilibrium employment.

There are 2 ways to answer.
Option 1:

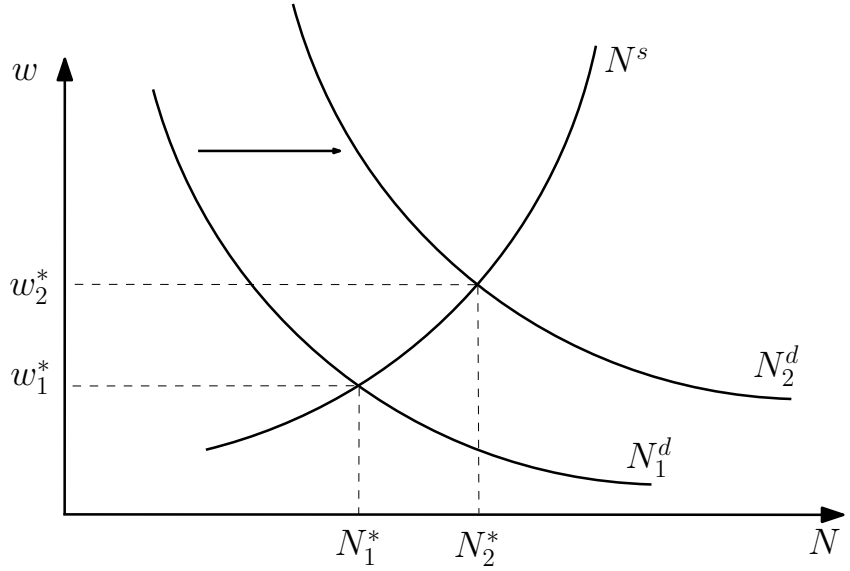


- Definition of variables

$w^*, w^s_{sub}, w^d_{sub}$	:	equilibrium wage, subsidized wage for supply and demand
τ	:	subsidy (percent of wage)
N^s, N^*, N^{sub}	:	labor supply, equilibrium employment, subsidized employment

- 2 wages: workers receive w^s_{sub}, firms pay w^d_{sub}
- subsidy $\tau w^d_{sub} = w^s_{sub} - w^d_{sub}$
- results: $w^s_{sub} > w^*$, and $w^d_{sub} < w^*$, employment $\uparrow$

Option 2:



- Definition of variables

w_1^*, w_2^*	:	equilibrium wage without and with subsidy
τ	:	subsidy (percent of wage)
N^s, N_1^*, N_2^*	:	labor supply, equilibrium employment without and with subsidy

- N^d shifts to the right, because for every market wage, the firm receives a subsidy and will demand more labor.
- Results: $w^* \uparrow,\ N^* \uparrow$
- subsidy τw_2^* goes to the firm

Part iv) *(5 points)*

Discuss how you could design an empirical test of your result in iii) using only macro data. Name one drawback of such a test.

Note: There are again various possible answers. This is one elaborate example, but any coherent selection of it would do.

- Need data on:
  - employment or labor force participation rate
  - average labor subsidies
- time-series, or better cross-country (because more variation)
- Data-source: OECD or various national statistics organizations
- Run regression like $empl_{i,t} = \beta_{i,0} + \beta_1 subs_{i,t} + \epsilon_{i,t}$
- check sign of coefficient, we expect $\beta_1 > 0$
- Problem: *(only one bullet-point is sufficient)*
  - correlation vs causation
  - hard to measure subsidies
  - too little cross-country data
  - lots of cross-country heterogeneity (many controls needed)
  - other policy or market changes at the same time (again, many controls needed)

Question 5 (20 points)

Consider the Cobb-Douglas production function, $Y = A \cdot K^{\alpha} \cdot L^{1-\alpha}$, where Y is output, K is capital, L is the number of (employed) workers, A is total factor productivity, and $0 < \alpha < 1$.

Part i) *(2 points)*

Write down the growth accounting identity that decomposes growth in output into three different components.

- *no need to define variables, since all defined in question*
- The growth accounting equation is

$$\frac{\Delta Y_{t+1}}{Y_t} = \frac{\Delta A_{t+1}}{A_t} + \alpha \frac{\Delta K_{t+1}}{K_t} + (1-\alpha)\frac{\Delta L_{t+1}}{L_t} \tag{1}$$

Part ii) *(2 points)*

Suppose that $\alpha = 0.4$ and that output growth is 2%, capital growth is 1%, and there is no growth in L. What is the growth rate of total factor productivity?

- We can solve the growth-accounting equation (1) for TFP growth:

$$\begin{aligned} \frac{\Delta A_{t+1}}{A_t} &= \frac{\Delta Y_{t+1}}{Y_t} - \alpha \frac{\Delta K_{t+1}}{K_t} - (1-\alpha)\frac{\Delta L_{t+1}}{L_t} \\ &= 2\% - 0.4 \cdot 1\% - 0.6 \cdot 0\% \\ \frac{\Delta A_{t+1}}{A_t} &= 1.6\% \end{aligned} \tag{2}$$

Part iii) *(4 points)*

How would you extend the equation from part i) to account for human capital growth? If human capital growth was 2%, how would your estimate of the growth rate of total factor productivity change?

add the growth rate in average human capital (h) to the growth-accounting equation:

$$\frac{\Delta Y_{t+1}}{Y_t} = \frac{\Delta A_{t+1}}{A_t} + \alpha\frac{\Delta K_{t+1}}{K_t} + (1-\alpha)\frac{\Delta L_{t+1}}{L_t} + (1-\alpha)\frac{\Delta h_{t+1}}{h_t} \tag{3}$$

Then

$$\begin{aligned} \frac{\Delta A_{t+1}}{A_t} &= \frac{\Delta Y_{t+1}}{Y_t} - \alpha\frac{\Delta K_{t+1}}{K_t} - (1-\alpha)\frac{\Delta L_{t+1}}{L_t} - (1-\alpha)\frac{\Delta h_{t+1}}{h_t} \qquad (4) \\ &= 2\% - 0.4 \cdot 1\% - 0.6 \cdot 0\% - 0.6 \cdot 2\% \\ \frac{\Delta A_{t+1}}{A_t} &= 0.4\% \end{aligned}$$

Part iv) *(4 points)*

Briefly outline the general steps needed to predict future output growth.

Need predictions on

- the capital share α or the labor share $1-\alpha$ in national income.
- growth in factor inputs (growth of the labor force, capital deepening, human capital accumulation)
- growth in TFP (technological progress, reorganization of production process, learning, ...)

For each prediction, need to specify underlying assumptions, e.g. α stays constant, TFP is assumed to continue to grow at the same rate as the last 10 years.
Insert predictions into growth-accounting equation (1) to forecast output growth.

Part v) *(4 points)*

Name two government policies that may enhance productivity growth. Provide a brief explanation.

Note: Here are just a few examples:

- trade opening: competitive pressure on domestic firms increases, because they have to face successful international competitors ⇒ unproductive firms drop out or have to become more efficient ⇒ TFP ↑

- Patent protection, or smoother, faster patent granting process: incentive to innovate $\Rightarrow$ TFP $\uparrow$
- Direct tax break or subsidy for R&D: same mechanism as in last point.
- Subsidies for 'innovative' industries: e.g. computer components, which have a fast innovation cycle, and also productivity spill-overs into other industries

Part vi) *(4 points)*

Name two government policies that may increase the growth rate of employed workers at least temporarily. Provide a brief explanation.

Note: Here are just a few examples:

- Introduce a wage subsidy as described in Q4, iii). As shown there, equilibrium employment would increase, at least for the one period.
- Increase public employment, e.g. hire more professors at universities.
- Reduce unemployment insurance: increases the job finding rate, and reduces unemployment, thus increasing $\Delta L/L$.
- Reduce labor income taxes: gives more incentives to work, workers who didn't want to work now might decide to do so. Already employed workers might work more hours.