

Вопрос **Инфо**

Уважаемые участники!

Олимпиадное задание по направлению «Экономика» состоит из двух частей:

**Инвариантная часть** представлена заданиями № 1-2. Их нужно выполнить всем участникам.

**Вариативная часть** разделена на треки:

- Трек «Финансовая экономика»: задания № 3-4.
- Трек «Экономика»: задания № 5-8.

Вы можете сосредоточиться на выполнении заданий одного трека (чтобы претендовать на статус дипломанта I, II, III степени) или постараться решить наибольшее число задач вне зависимости от треков, чтобы претендовать на статус медалиста.

Во время выполнения заданий вы можете использовать встроенный в систему калькулятор и черновик, но на проверку он не предъявляется. Использование сторонних ресурсов и справочных материалов строго запрещено.

Верим в ваш успех!

Вопрос **1**

Балл: 25,00

*Инвариантная часть. Это задание нужно выполнить всем участникам.*

Consider an open economy with sticky prices and wages and imperfect capital mobility, where the equilibrium can be described by the IS-LM-BP model. Consumption function is given by  $C = 10 + 0,8(Y - T)$ , where  $Y$  is the real output,  $T$  is net tax revenue;  $T = 5$ . Investment function is given by  $I = 20 - 0,2r$ , where  $r$  is the real interest rate, measured in percentages. Government purchases  $G = 10$ , net export function is given by  $X_n = 15 - 0,2Y + 4E$ , where  $E$  is the exchange rate (the price of a foreign currency in units of the domestic currency). Nominal money supply  $M$  equals 100; price level  $P$  equals 2; real money demand function is given by  $L(Y, r) = 0,2Y - 0,6r$ . Balance of payments equilibrium is determined by the equation  $CA + CF = 0$ , where  $CA$  is current account balance, which is equal to net export,  $CF$  is capital account balance, which is determined as

$CF = k(r - r^f) - 24$ , where  $r^f$  is foreign real interest rate,  $k$  is a parameter.

Assume that domestic inflation and foreign inflation are equal to zero, so nominal interest rate equals real interest rate both in domestic and foreign market.

(a) (4 points) According to the economic intuition, should the parameter  $k$  be positive or negative? How does the degree of capital mobility depend on the parameter  $k$ ? Explain your answers.

(b) (6 points) Write the equations of IS, LM and BP curves. For each of these curves find out, whether its slope in  $(Y; r)$  space is positive or negative and explain the result intuitively.

(c) (4 points) Find the equilibrium output if  $k = 2$  and  $r^f = 2$ . Illustrate the equilibrium

graphically in  $(Y; r)$  space.

(d) (8 points) Following a negative shock the capital account balance decreased for each  $r$  and  $Y$ . Explain the effect of this shock on domestic output and illustrate changes in  $(Y; r)$  space, if

(i) the central bank maintains a fixed exchange rate;

(ii) the exchange rate is flexible.

(e) (3 points) What will change in the balance of payments, if a country makes a transition to zero capital mobility? Explain your answer.

Вопрос 2

Балл: 25,00

*Инвариантная часть. Это задание нужно выполнить всем участникам.*

Consider a static two-country (AA and BB) equilibrium model. Each country consists of a representative consumer and a firm. The representative consumer in each country purchases both domestically produced and imported consumer goods, but also obtains utility from leisure time. The utility function of the representative consumer from country  $k$ ,  $k = A, B$ , is given by  $u^k(c_k^k, c_j^k, l^k) = (c_k^k)^{0,25} (c_j^k)^{0,25} (l^k)^{0,5}$ , where  $c_j^k$  denotes representative consumer  $k$  consumption of a consumer good produced in country  $j$ ,  $k \neq j$ ,  $j = A, B$ ;  $c_k^k$  denotes representative consumer  $k$  consumption of the domestically produced consumer good;  $l^k$  denotes leisure time for representative consumer  $k$ . There are no endowments of consumer goods (or money). Each representative consumer has an endowment of time  $\bar{L}^k$ , which is allocated between leisure and time to work (labour to supply),  $k = A, B$ ,  $\bar{L}^A > \bar{L}^B$ . Labour is immobile. The available technology allows the firm from country  $k$  to produce  $y^k$  units of consumer goods from one hour of labour, so  $c_k^k = y^k L^k$ , where  $c_k^k$  denotes the amount of the consumer good produced in country  $k$ ,  $L^k$  denotes hours spent on production in country  $k$ ,  $k = A, B$ ,  $y^A > y^B$ .

The representative consumers and the firms are price takers.

Let  $p_k$  denote a uniform price of the consumer good produced in country  $k$ ,  $k = A, B$ , and let  $p_A = 1$ . Let  $w_k$  denote wage rate per hour in country  $k$ ,  $k = A, B$ .

(a) Find the Walrasian equilibrium (equilibrium prices and allocation).

(b) In which country is the wage rate higher? Compare  $p_A = 1$  and  $p_B$  (the prices of consumer goods in countries AA and BB). In which country is the utility higher?

(c) Suppose that country BB has introduced an ad valorem tax on the purchase of the consumer good produced in country AA, i.e. for a unit of consumer good from country AA the consumer from country BB pays  $p_A(1 + \tau)$ , where  $\tau$  is the ad valorem tax rate. Tax revenue adds to the income of country BB's consumer. Find the Walrasian equilibrium. How will the utility change in country BB?

Вопрос 3

Балл: 25,00

*Задание по треку «Финансовая экономика». Это задание учитывается в рейтинге по треку «Финансовая экономика» и в рейтинге медалистов.*

**Answer this question in English. Graders will ignore any Russian text.**

**You must label each problem and its sub-questions clearly and sufficiently.**

The economy lasts three periods,  $t = 0, 1, 2$ . Investors have access to a risk-free asset and a risky asset. The risk-free asset is long-lived: it pays off at  $t = 1$  and  $t = 2$ . Its risk-free return between  $t = 0$  and  $t = 1$  is  $r$ . However, its return between  $t = 1$  and  $t = 2$  is known to all investors before investing at  $t = 1$ , but not at  $t = 0$ . There are two states of the world at time 1. In the up state, the risk-free return is  $r(u) = 1.02\%$ . In the down state, the risk-free return is  $r(d) = 1.01\%$ . Both states are equally likely. This distribution is common knowledge.

The risky asset is short-lived: it pays off at  $t = 1$  only. Its return is 0 in the up state, and  $2r$  in the down state. Note that because the risky asset is short-lived, investors can only invest in the risky-free asset at  $t = 1$ . All interest rates are gross.

Consider a risk-averse investor who cares about his wealth at  $t = 1$  only.

- [2 points] Determine the expected return of the risky asset at  $t = 0$ .
- [3 points] Explain intuitively whether the risk-averse investor will demand the risky asset at  $t = 0$ . *Hint:* think of lotteries and certainty equivalents.

Consider now a risk-averse investor who cares only about his wealth at  $t = 2$ . The investor has initial wealth  $W$ .

- [6 points] Let  $f$  denote the fraction of the investor's wealth invested in the risky asset at  $t = 0$ , so that a fraction  $1 - f$  of the wealth is invested in the risk-free asset. Write the investor's wealth at  $t = 1$  in each state of the world as a function of  $W$ ,  $f$ ,  $r$  and  $r(u)$  or  $r(d)$ . Write the investor's wealth at  $t = 2$ .

Suppose that the utility of the risk-averse investor is  $U(W_2) = \frac{W_2^{1-a}}{1-a}$  .

- [8 points] Derive the demand for the risky asset of the investor at  $t = 0$ . Explain intuitively why the investor may demand the risky asset.
- [6 points] How does the demand for the risky asset change with  $a$ ? Give the intuition for your results.

Вопрос 4  
Балл: 25,00

*Задание по треку «Финансовая экономика». Это задание учитывается в рейтинге по треку «Финансовая экономика» и в рейтинге медалистов.*

**Answer this question in English. Graders will ignore any Russian text.**

**You must label each problem and its sub-questions clearly and sufficiently.**

Imagine a firm that has a zero-coupon debt with face value  $F$  to be repaid next period. The firm has own cash of 20, available for investment. Next period the firm will generate a cash flow and will be liquidated with zero salvage value. The CEO of the firm has three options available today:

- (1) Investing the available cash in project A. Then the firm will generate 50 with certainty next period;
- (2) Investing the available cash in project B. Then the firm will generate either 10 or 80 with equal probabilities next period;
- (3) Paying out the available cash to the shareholders as a dividend. Then the firm will not generate any cash flow next period.

At any moment, the CEO *acts in the interest of the firm's original shareholders*. The shareholders have *limited liability* and there are *no costs of bankruptcy*. There is *no discounting* and *everybody is rational and risk-neutral*.

**Definition:** A zero coupon debt (bond) with face value  $F$  entitles the debtholder to receive the fixed amount  $F$  out of the realized cash flow, and the shareholders receive the rest. If the realized cash flow is less than  $F$ , the debtholder receives the whole cash flow, and the shareholders get 0 (due to their limited liability).

- [5 pts] Find the choice of CEO for each value of  $F \in [0, \infty)$

## ЭКОНОМИКА

For the remaining parts assume the following: There is no option (3). Projects A and B are available, but either of them requires an investment of the amount  $X$ , which is known to everybody. The firm has no own cash, hence it needs to raise these funds in the capital market. If the funds are not raised, the firm generates a zero cash flow. The firm has ***no current debt obligations***. The market is ***perfectly competitive***, meaning that, for any offered security, investors are ready to pay the expected cash flow it generates. Suppose the only way to raise funds is by issuing zero-coupon debt. That is, the CEO offers a bond with face value  $F$ , as defined above, and the investors decide whether to provide  $X$  or not.

2. [5 pts] Suppose that before raising funds the CEO *can commit* to the choice of the project. Find for what values of  $X$  he will raise financing and which project he will select.
3. [7.5 pts] Suppose now the CEO *cannot commit* to the choice of the project. That is, once the funds are raised, the CEO is free to choose either project. For each value of  $X$ , find whether the CEO will raise financing and which project he will implement.
4. [7.5 pts] Keep assuming that the CEO cannot commit to the choice of the project, but suppose now the firm could issue debt convertible into equity. Convertible debt with face value  $F$  and conversion rate  $\alpha \in [0,1]$  allows the creditors to choose between collecting  $\min\{F, CF\}$  (no conversion) and receiving  $\alpha \cdot CF$  (conversion), where  $CF$  is the realized cash flow. Assume that the decision to convert can be taken after the realization of the cash flow is observed (but before any distribution of cash). Suppose  $X = 30$ . Show (an example is enough) that the firm's shareholders could improve their welfare relative to part (c) by issuing convertible debt that the creditors would actually not convert in equilibrium.

### Вопрос 5

Балл: 10,00

*Задание по треку «Экономика». Это задание учитывается в рейтинге по треку «Экономика» и в рейтинге медалистов.*

Natural population decline in Russia reached 1,04 million people in 2021: this is the biggest figure since 2000. The reason behind the sad record is the pandemic. Analysts state that excess mortality and disease rate will negatively impact Russia's GDP, and these factors account for up to 0,1% GDP loss annually. The effect tends to be long-term.

**(a) (5 points)** Using a relevant macroeconomic model, explain intuitively how negative population shock will affect output and price level in the short run and in the long run. Illustrate your answer with a graph.

**(b) (3 points)** However, the net migration flow in 2021 has risen three times compared to 2020 due to a partial removal of border restrictions and prolongation of residence for labor migrants within Russia. Explain intuitively how higher net migration flow can affect output in the short run and in the long run. Illustrate your answer with a graph.

**(c) (2 points)** Propose two policy measures that can be adopted by the Russian government to make population grow instead of decline (suppose that the pandemic has come to an end). Explain intuitively.

### Вопрос 6

Балл: 10,00

*Задание по треку «Экономика». Это задание учитывается в рейтинге по треку «Экономика» и в рейтинге медалистов.*

Consider a quasi-linear economy with a linear demand function (for positive quantities) and a linear supply function (also for positive quantities). Suppose a unit tax is imposed. How will the deadweight loss (DWL) change when the tax rate increases by  $\lambda > 0$  times? (Assume that a positive amount of good is produced/consumed in the economy before and after the shift of the tax).

Вопрос 7

Балл: 15,00

*Задание по треку «Экономика». Это задание учитывается в рейтинге по треку «Экономика» и в рейтинге медалистов.*

In 19XX in a country N annual inflation rate reached 700% and the N's government decided to carry out economic reforms, especially in the monetary sphere. "Shocking therapy" disinflation policy included strict control of inflation, normalization of the government budget balance and exchange rate fixation. Moreover, the government imposed a legal ban on monetary deficit financing by the Central bank.

**(a) (4 points)** Explain the difference between gradualism and shocking therapy as two types of disinflation policies. Is shock therapy an unexpected policy?

**(b) (3 points)** Explain how monetary financing of the budget deficit can lead to a high inflation.

**(c) (8 points)** Using Phillips curve, compare the output loss from gradualism disinflation policy and from "shocking therapy" disinflation policy given rational and adaptive inflation expectations. Illustrate your answer with a graph.

Вопрос 8

Балл: 15,00

*Задание по треку «Экономика». Это задание учитывается в рейтинге по треку «Экономика» и в рейтинге медалистов.*

Consider a market for a homogeneous good. There are N firms in the market. The inverse demand function is  $p(y)$ , with  $p'(y) < 0$ , where  $y$  is the total output of the industry. All firms have constant unit costs. The unit cost of a firm  $i$  is denoted by  $c_i$ ,  $i = 1, \dots, N$ . The firms have different unit costs. Let  $y_i$  denote firm  $i$ 's output  $i = 1, \dots, N$ ,  $y_i > 0$ . Firms are involved in Cournot competition.

Prove or disprove that for any arbitrary demand function the mean profit of N firms is a linear and increasing function of the unit cost variance (dispersion) within the firms and

$$\pi_N = \frac{1}{N} \sum_{i=1}^N \pi_i = \frac{1}{-p'(y)} (\sigma^2 + \mu^2) \quad \pi_N = \frac{1}{N} \sum_{i=1}^N \pi_i = \frac{1}{-p'(y)} (\sigma^2 + \mu^2),$$

where  $\sigma^2$  denotes the unit cost variance (dispersion) within the firms, so

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^N (c_i - \bar{c}_N)^2 \quad \sigma^2 = \frac{1}{N} \sum_{i=1}^N (c_i - \bar{c}_N)^2, \quad \mu$$

$$\mu = p(y) - \bar{c}_N = -\bar{y}_N p'(y) \quad \mu = p(y) - \bar{c}_N = -\bar{y}_N p'(y), \quad \text{where } \bar{c}_N = \frac{1}{N} \sum_{i=1}^N c_i$$

$$\bar{y}_N = \frac{1}{N} \sum_{i=1}^N y_i$$