Remarks

i. The following aids can be used: dictionary, calculator according to the examination office's list.

ii. The exam consists of **three** open **questions**, which all have to be answered.

iii. Total available time are **60 minutes**.

iv. Please write readable and leave a margin at the right for corrections.

v. The questions can be answered either in English or in German.

Problem 1

Problem 1 refers to the sophisticated tax competition model of the lecture. Consider an economy with $n = 2$ countries. Each country $i = 1, 2$ accommodates one representative firm and is populated by one representative household that is the owner of the firm in country i. The capital endowment of the household is $\overline{k}_i$. In country i the firm produces the output according to the production function $F(k_i)$, where k_i denotes the capital input. The production function exhibits positive and decreasing marginal returns to capital. Capital is perfectly mobile. The household generates utility U from private good consumption c_i and public good consumption g_i, i.e. $U = U(c_i, g_i)$. The quantity of private good consumption is equivalent to the household's income Y^i. The public good is financed by a source-based tax t_i on employed capital. Capital is remunerated at the world interest rate r. The capital market equilibrium determines r and k_i as functions of the tax rates $(t_i, \ldots, t_n)$. [Hint: In the following you don't have to determine formally the impact of tax rates on r and k_i, but you may use $\partial r / \partial t_i < 0$ and $\partial k_i / \partial t_i < 0$ without proof.]

i. Assume perfectly identical countries and welfare maximizing national governments.

   Derive algebraically the Nash equilibrium and show that it is determined by an underprovision of the public good. Provide also an intuition for the equilibrium condition. **(25 percent)**

ii. The basic tax competition results depends crucially upon the symmetry assumption. In reality we observe significant differences in country size. which should be here reflected by different capital endowments. Country 1 is defined as large, i.e. $\overline{k}_1 > \overline{k}$ whereas country 2 is small, i.e. $\overline{k}_2 < \overline{k}$. The expression $\overline{k}$ indicates the average capital stock.

   Prove that in the non-coordinated equilibrium underprovision does not necessarily hold. Explain the driving forces behind this result. Use an adequate graphical representation to illustrate your findings. **(20 percent)**

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Problem 2

Consider a world consisting of two identical countries home and foreign, $i = h, f$, with international trade. In both countries two homogeneous goods, $j = x, y$, are produced and consumed on competitive markets. Country i is populated by one representative household, whose utility function is $U^i = U^i(x_i, y_i)$, where x_i and y_i stand for the quantities consumed. The production possibilities frontier is given by $T^i(X^i, Y^i)$, where X^i and Y^i show the quantities produced. The consumer prices are given by p_{ix} and p_{iy}, the producer prices are defined as q_{ix} and q_{iy}. Each country levies a uniform value added tax on all consumption goods, i.e. $t_{ix} = t_{iy} = t_i$. The tax rates can differ between the countries.

i. Define the scope of the two basic principles to tax international commodity trade. Why does the use of the principles require international coordination? (5 percent)

ii. Explain intuitively the necessary conditions for an Pareto efficient allocation within the world. [You don't have to derive formally these conditions.] (10 percent)

iii. Prove algebraically if the efficiency conditions under the two taxation principles are fulfilled. Which fact does change your derived results and what are the allocative consequences? (15 percent)

Problem 3

In 2001 European Commission proposed to replace the current corporate taxation system *Separate Accounting* by *Formula Apportionment* to reduce profit shifting activities of multinational enterprises (MNE).

i. Explain shortly the basic working mechanism of both systems. (5 percent)

ii. Assume $n \geq 2$ countries. Give an algebraic representation of the apportionment formula in country i, A^i, and of the effective tax rate, τ, for the MNE. The formula should contain three equally weighted factors and the weights sum up to 1. These factors are assets k_i, payroll $w_i l_i$ and sales based on the destination principle $p_i x_i$. Explain with the help of these two figures intuitively the distortions and fiscal externalities introduced by *Formula Apportionment*. (15 percent)

iii. The European „...*Commission Services believe that sales by origin has a a weak conceptual basis as an income generating and apportioning factor. First of all, it replicates to a significant extent the role played by assets and payroll as income generating factors.* "

Can you share this opinion? Give reasons for your result. (5 percent)