Exam ECON5200

Problem 1: This question is based on "The Gas Trap: Outcompeting Coal vs. Renewables" by Harstad and Holtsmark, NBER Working Paper No. 32718, 2024.

1. Consider the preferences of the representative consumer of country M described in equation (2). For a fixed price p and tax τ_M, are the preferences of the representative consumer in M convex where the domain of preferences is the total energy consumption?

2. Suppose that instead of having the price enter the utility directly, the representative consumer has the following preferences: $u(y_M, z) = b(y_M) + z$ where $z \in \mathbb{R}$.[1] Endow the consumer with wealth w. Let p be the price of y_M and set the price of z equal to one. Set up the consumer maximisation problem. How does the solution varies with wealth w? How does it compare to the solution in (2) in the paper?

3. What are the preferences represented by the utility function $u(y_M, z) = b(y_M) + z$ called? How would your answer to the preceding question change if the preferences of the consumer are represented by the utility function $\tilde{u}(y_M, z) = b(y_M) + z - t$ for some $t > 0$. What property of these preferences does your answer to this question illustrate?

4. The article assumes that all energy sources are traded at the same price. In this question, we will argue that this would be the case in a competitive market. Let y_c, y_g and y_r denote the consumption of coal, gas and renewable energy of the representative consumer in country M. The representative consumer now has the following preferences: $u(y_c, y_g, y_r, z) = b(y_c + y_g + y_r) + z$ with $z \in \mathbb{R}$. Let p_c, p_g and p_r denote the price of coal, gas and renewable energy. The price of z is normalised to one.

   Set up the consumer's utility maximisation problem. Show formally that if the consumption of all sources of energy is strictly larger than zero, the price of all energy sources must be equal.

5. Suppose the preferences of the representative consumer now included the damage from the production of energy, $a \cdot h(e_G x_G)$: $u(y_g, y_r, z, x_G) = b(y_g + y_r) + z - ah(e_G x_G)$.[2] Do you expect a general equilibrium with these preferences to be Pareto efficient? Same question if the damage function is $ah(e_G y_g)$? You do not need to show these results mathematically.

[1] Note that we allow z to have negative values.

[2] I only include the production of gas as country M does not produce coal. We completely abstract from country N. So for this question, you should only consider a general equilibrium where there is a producer of gas and renewable energy and the only consumer is the representative consumer in M.

Problem 2: This question is based on "The Political Economy of Zero-Sum Thinking" by Ali, Mihm and Siga, forthcoming at *Econometrica*. All the questions are based on the example described in the introduction.

1. Describe the game formally as a game of incomplete information.
2. Show formally that the equilibrium of the example described in the introduction is a Bayes Nash Equilibrium. Assume that $\lambda < 1/3$.
3. Find another equilibrium than the one described. Prove that it is an equilibrium.
4. Suppose that all the players are fully informed about who are the winners and the losers of the policy. For the winners, is voting p_* strictly dominated?