Ph.D. MICROECONOMICS CORE EXAM
August 2015

This exam is designed to test your broad knowledge of microeconomics. There are three sections: one required and two choice sections. You must complete both problems in the required section and one choice problem in each of the two choice sections, giving you a total of four problems to complete during the allotted time. The required problems are in section A and the choice problems are in sections B and C. If you should answer more than one choice question in a section, only the first will be considered.

IMPORTANT. You are expected to adhere to the following guidelines in completing the exam for your answer to be considered complete. Incomplete answers will be evaluated accordingly.

- Write legibly. **Number all pages and organize your answers to questions in the same order as they were given to you in the exam. Begin your answer to each question on a new page and identify the question number.**
- Provide clear, concise discussion to your answers.
- Explicitly state all assumptions you make in a problem. Graders will not take unstated assumptions for granted. Do not make so many assumptions as to trivialize or assume the problem away.
- Define any notation you use in a problem and label all graphs completely.
- Explain your steps in any mathematical derivations. Simplify your final answers completely.
- When you turn in your exam answers double check to make sure you have included all the pages to each question number, in order. The pages you submit as your answer are the only ones that will be considered.
- To simplify copying, please leave 1 inch borders.

QUESTION A2

Suppose you have a consumer with the following utility function:

$$u(x, y) = 3x + y$$

a. Derive the indirect utility.
b. Derive the expenditure function.
c. $P_x = \$2;\ P_y = \$1; m = \$20$. Suppose the government imposes a sales tax $t = \$2$ on good x. How much would the consumer have to be compensated to be as well off as they were before the tax was imposed? What if $P_y = \$2$, would your answer change?
d. Suppose the government instead imposes an income tax. Is the consumer better off with the sales tax or the income tax? Is this result consistent with WARP? Explain.

QUESTION B2

The perfectly competitive Dig-It School offers instruction in driving backhoes (see Figure 1 below). The School's production function is $q = 10 * \min\{k, l\}^{\gamma}$, where q is the number of students trained, k is the number of backhoes, l is the number of instructors, and γ is a parameter indicating returns to scale in the production function.

a. What restrictions are required on the value of γ in order for a profit-maximizing solution to exist and why? (Assume $q > 0$.)
b. Assume γ=0.5. Calculate the School's total cost function and profit function. (Use p to denote the price paid by each student.)
c. If the cost of a backhoe is \$1000 per student, the cost of an instructor is \$500 per student, and the price paid by students is \$600, how many students will Dig-It train and what are its profits?
d. If the students' willingness to pay rises to \$900, how much will profits change?

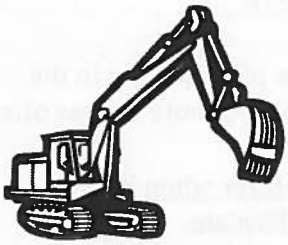

Figure 1: Picture of a backhoe

QUESTION C2

Crude oil is transported across the globe in enormous tanker ships called Very Large Crude Carriers (VLCC's). By 2001, more than 92% of all new VLCC's were built in South Korea and Japan. Assume that the price of new VLCC's (in millions of dollars) is determined by the function $P = 180 - Q$, where $Q = q_{Korea} + q_{Japan}$. (That is, assume that only Japan and Korea produce VLCC's, so they are a duopoly). Assume that the cost of building each ship is \$30 million in both Korea and Japan. That is, $c_{Korea} = c_{Japan} = 30$, where the per-ship cost is measured in millions of dollars.

a. Write the profit function for each country in terms of q_{Korea} and q_{Japan} and either c_{Korea} or c_{Japan}. Find each country's best-response function.
b. Using the best-response function found in part a, solve for the Nash equilibrium quantity of VLCC's produced by each country per year. What is the price of a VLCC? How much profit is made in each country?
c. Labor costs in Korean shipyards are actually much lower than in their Japanese counterparts. Assume now that the cost per ship in Japan is \$40 million and that in Korea it is only \$20 million. Given $c_{Korea} = 20$ and $c_{Japan} = 40$, what is the market share of each country? What are the profits for each country? Discuss and compare your answer to part b.
d. Suppose China decides to enter the VLCC construction market. The duopoly now becomes a triopoly, so that although price is still $P = 180 - Q$, quantity is now given by $Q = q_{Korea} + q_{Japan} + q_{China}$. Assume that all three countries have a per-ship cost of \$30 million: $c_{Korea} = c_{Japan} = q_{China} = 30$. With this new information, write the profit functions for each country. Find each country's best response rule and interpret. Find the profit and quantity produced in each country. Be sure to explain what happens to the price of a VLCC in the new triopoly relative to the duopoly situation in part a and b.