Solutions to Homework 4

AEC 504 - Summer 2007

Fundamentals of Economics

1 General Equilibrium in the Endowment Economy

Consider an economy populated by two identical agents A and B with preferences given by $U = XY$. A is endowed with 2 units of X and 1 unit of Y and B is endowed with 1 unit of X and 5 units of Y.

i. Assume A and B are price takers. Compute their demand and excess demand for X and Y. What is the market demand for X and Y?

$$Demand: \quad X_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_X} = 1+\frac{1}{2}p, \quad Excess\ Demand: \quad X_A - X_0^A = \frac{1}{2}p - 1$$

$$Demand: \quad Y_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_Y} = \frac{1}{2} + \frac{1}{p}, \quad Excess\ Demand: \quad Y_A - Y_0^A = \frac{1}{p} - \frac{1}{2}$$

$$Demand: \quad X_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_X} = \frac{1}{2}+\frac{5}{2}p, \quad Excess\ Demand: \quad X_B - X_0^B = \frac{5}{2}p - \frac{1}{2}$$

$$Demand: \quad Y_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_Y} = \frac{5}{2}+\frac{1}{2p}, \quad Excess\ Demand: \quad Y_B - Y_0^B = \frac{1}{2p} - \frac{5}{2}$$

$$Market\ Demand: X = \frac{3}{2} + 3p, \quad Y = 3 + \frac{3}{2p}$$

ii. Define the equilibrium in the market for X and compute the equilibrium price $P \equiv p_Y/p_X$. What is the market demand for Y at this price? Is it accidental?

In the equilibrium the market demand for X is equal to the total endowment of X in the economy, or, equivalently, the excess market demand for X is zero.

$$\frac{3}{2} + 3p = 3 \Rightarrow p = \frac{1}{2}$$

Quite intuitively, in the economy, where the total endowment of X is twice smaller than the total endowment of Y and consumers like X and Y equally, X is twice as expensive as Y.

At the relative price of $1/2$ the market for Y is also in equilibrium. It is not accidental: in a model of N markets we only need to bring $N-1$ markets to the equilibrium, and the last one will clear automatically.

iii. What is the equilibrium allocation of goods? What is the utility change brought about by the trade?

$$X_A = \frac{5}{4},\ Y_A = \frac{5}{2}, \quad X_B = \frac{7}{4},\ Y_A = \frac{7}{2}$$

It is quite natural that the consumption of X by both agents is twice smaller than their consumption of Y - both of them like X and Y equally, and Y is twice cheaper than X.

iv. Draw the Edgeworth box for the economy and compute the locus of all Pareto-efficient points (aka the contract line). Draw the contract line in the Edgeworth box

The contract line is computed by equating their MRS:

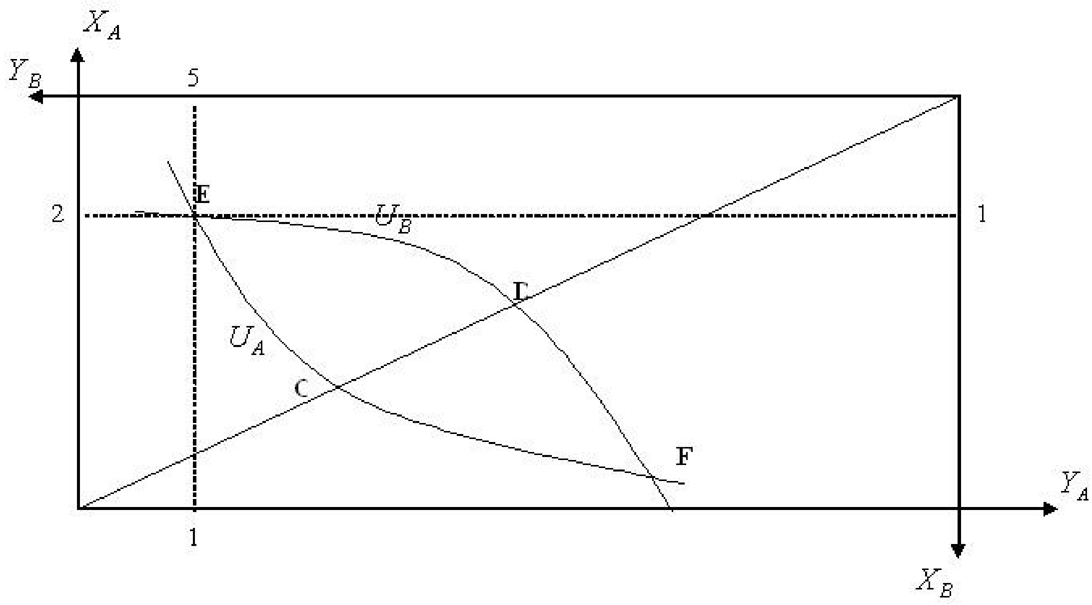
$$MRS_A = MRS_B \Rightarrow \frac{Y_A}{X_A} = \frac{Y_B}{X_B} = \frac{6-Y_A}{3-X_A} \Rightarrow 3Y_A - X_AY_A = 6X_A - X_AY_A \Rightarrow Y_A = 2X_A$$

See the picture in (v).

v. Draw the initial allocation in the Edgeworth box. What is the set of allocations that improve the welfare of both A and B compared to the initial allocation? Which of these allocations are efficient?

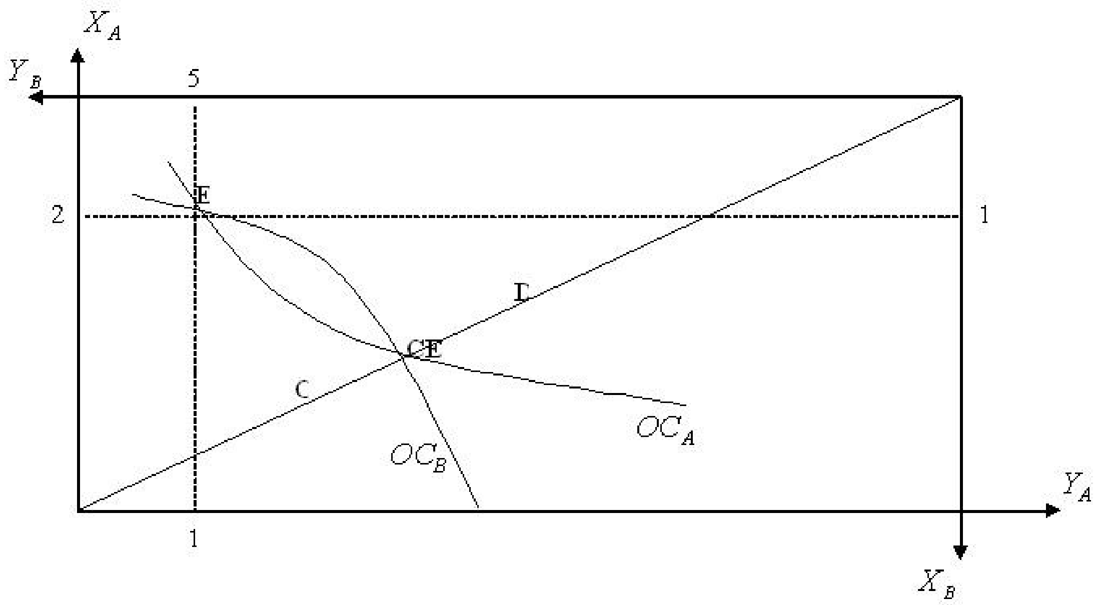
See the picture below.

The allocations between the indifference curves passing through the initial endowment point E (2,1) will improve the welfare of both A and B (region EFCD on the graph). The efficient allocations that will improve the welfare of both A and B are on the segment CD (all points between the indifference curves that are also on the contract line).



vi. Draw the offer curves and depict the competitive equilibrium in the economy. Is the equilibrium efficient? Why?

The equilibrium is efficient because the offer curves intersect when both A and B make an optimal choice at the same price. So, their indifference curves are tangent in this point ($MRS_A = MRS_B$ ***), which means efficiency.***



vii. Suppose A knows B's preferences and can make a take-it-or-leave-it (TIOLI) offer in terms of X and Y. If B rejects the offer, there is no trade. What will the resulting allocation be? Will it be efficient?

Hint: B will reject offers that make him worse off than the initial allocation, and accept all the other.

A will leave B on the indifference curve passing through the initial endowment. She will also want the resulting allocation to be efficient, because, by definition of Pareto-efficiency, she is always able to improve herself without hurting B in the inefficient allocation. Therefore, to find what to offer to B, A will solve

$$\begin{cases} \min\limits_{X,Y} 2X_B + Y_B \\ s.t. X_B Y_B = 5 \end{cases} \Rightarrow \begin{cases} \dfrac{MU_{X_B}}{MU_{Y_B}} = p \\ X_B Y_B = 5 \end{cases} \Rightarrow \begin{cases} \dfrac{Y_B}{X_B} = \dfrac{1}{2} \\ 2X_B^2 = 5 \end{cases} \Rightarrow \begin{cases} X_B = \dfrac{\sqrt{10}}{2} \\ Y_B = \sqrt{10} \end{cases}$$

Notice that on the graph in (v) this allocation is marked as point D - the intersection of the B's indifference curve that goes through the endowment and the contract line.

viii. Assume that A still knows B's preferences and can make a TIOLI offer, but now she can only offer a price, and B is free to choose the quantities he wants to exchange. What will the resulting allocation be? Will it be efficient?

If A knows B's preferences, she can figure out his demand for X ***and*** Y ***at both prices and what is left to her. The demands (from (i)) are:***

$$X_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_X} = \frac{1}{2} + \frac{5}{2}p, \; Y_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_Y} = \frac{5}{2} + \frac{1}{2p}$$

She then maximizes her utility given that she gets what is not demanded by B:

$$\max_p (\frac{5}{2} - \frac{5}{2}p)(\frac{7}{2} - \frac{1}{2p}) \Rightarrow FOC : \frac{(-14p^2 + 8)p + 7p^2 - 8p + 1}{p^2} = 0 \Rightarrow p = \frac{\sqrt{7}}{7}$$

The price is not 1/2, so the equilibrium is inefficient. You can check that in this equilibrium $MRS_A \neq MRS_B$***.***

ix. Suppose the government wants to take away a unit of X. The three proposals are:

a. Take away a unit of X from A.

b. Take away a unit of X from B.

c. Impose a 50% tax on the consumption of X by both A and B.

Compute the equilibrium price and the equilibrium allocation for all three cases. What happens to the welfare of A and B in all three cases? Are the equilibrium allocations efficient?

Hint: Do not confuse the consumption tax and the sales tax. The consumption tax is paid from all X they consume, not from what they trade.

a. Take away a unit of X from A.

The demand for X and Y changes for A, but stays the same for B:

$$X_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_X} = \frac{1}{2} + \frac{1}{2}p,\ Y_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_Y} = \frac{1}{2} + \frac{1}{2p}$$

$$X_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_X} = \frac{1}{2} + \frac{5}{2}p,\ Y_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_Y} = \frac{5}{2} + \frac{1}{2p}$$

The market-clearing condition for X is

$$\frac{1}{2} + \frac{1}{2}p + \frac{1}{2} + \frac{5}{2}p = 2 \Rightarrow p = \frac{1}{3}$$

$$X_A = \frac{2}{3},\ Y_A = 2, \quad X_B = \frac{4}{3},\ Y_A = 4$$

$$U_A = \frac{4}{3} < U_A^{iii} = \frac{25}{8}, \quad U_B = \frac{16}{3} < U_B^{iii} = \frac{49}{8}$$

The welfare of both A and B went down, even though only A's endowment decreased. It happened because A is the seller of the scarce good (X) and is able to push some of her loss on B, because X becomes even more scarce. The equilibrium is efficient, because $MRS_A = MRS_B = 3$

b. Take away a unit of X from B.

The demand for X and Y changes for B, but stays the same for A:

$$X_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_X} = 1 + \frac{1}{2}p,\ Y_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_Y} = \frac{1}{2} + \frac{1}{p}$$

$$X_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_X} = \frac{5}{2}p,\ Y_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_Y} = \frac{5}{2}$$

The market-clearing condition for Y is

$$\frac{1}{2} + \frac{1}{p} + \frac{5}{2} = 6 \Rightarrow p = \frac{1}{3}$$

$$X_A = \frac{7}{6},\ Y_A = \frac{7}{2}, \quad X_B = \frac{5}{6},\ Y_A = \frac{5}{2}$$

$$U_A = \frac{49}{12} > U_A^{iii} = \frac{25}{8}, \quad U_B = \frac{25}{12} < U_B^{iii} = \frac{49}{8}$$

Now the welfare of A goes up and the welfare of B goes down. A, the seller of the scarce good X, benefits from its becoming even more scarce. The equilibrium is still efficient, because $MRS_A = MRS_B = 3$

c. Impose a 50% tax on the consumption of X by both A and B.

Now each of them solves

$$\begin{cases} \max\limits_{X,Y} U = XY \\ s.t. \frac{3}{2}p_X X + p_Y Y \leq p_X X_0 + p_Y Y_0 \end{cases} \Rightarrow \begin{cases} X = \dfrac{p_X X_0 + p_Y Y_0}{3p_X} \\ Y = \dfrac{p_X X_0 + p_Y Y_0}{2p_Y} \end{cases}$$

$$X_A = \frac{p_X X_0^A + p_Y Y_0^A}{3p_X} = \frac{2}{3} + \frac{1}{3}p,\ Y_A = \frac{p_X X_0^A + p_Y Y_0^A}{2p_Y} = \frac{1}{2} + \frac{1}{p}$$

$$X_B = \frac{p_X X_0^B + p_Y Y_0^B}{3p_X} = \frac{1}{3} + \frac{5}{3}p,\ Y_B = \frac{p_X X_0^B + p_Y Y_0^B}{2p_Y} = \frac{5}{2} + \frac{1}{2p}$$

Whatever they do, the government will take 1 unit of X and leaves only 2 units in the economy, so the market-clearing condition for X is

$$\frac{2}{3} + \frac{1}{3}p + \frac{1}{3} + \frac{5}{3}p = 2 \Rightarrow p = 2$$

$$X_A = \frac{5}{6},\ Y_A = \frac{5}{2}, \quad X_B = \frac{7}{6},\ Y_A = \frac{7}{2}$$

$$U_A = \frac{25}{12} < U_A^{iii} = \frac{25}{8}, \quad U_B = \frac{49}{12} < U_B^{iii} = \frac{49}{8}$$

The welfare of both A and B declines, because both suffer from the tax. The equilibrium is, however, efficient, because $MRS_A = MRS_B = 2$

x. Suppose the government decides that A is poorer than B and has to be exempt from the consumption tax on X. Without making any calculations, predict whether the resulting equilibrium will be efficient.

If A is exempt, A and B will effectively face different prices. Their MRS will be equal to the prices they face, but unequal to each other, meaning the equilibrium is inefficient. Notice that in (ix) the consumption tax did not cause inefficiency, because both A and B faced the same prices. This the general rule - if the tax does not make the trading parties face different prices, the outcome will be efficient. Unluckily, all real-life taxes do: the sales tax makes the seller's price and the buyer's price different, the income tax makes the wage paid and the wage received different, etc.

2 Monopoly and the Tragedy of Commons

When Snow White settled with the seven dwarfs, they promised her 10% of their total profits from diamond production. The dwarfs have the only diamond mine in the country, so they can act like a monopoly and face the demand curve $P = 100 - Q$, where Q is the number of diamonds they produce. It costs \$20 to produce a diamond.

i. If Snow White can tell the dwarfs how many diamonds to produce and they will comply, what number of diamonds will she choose? How much money will she get from them?

The first thing to notice here is that Snow White will maximize the total dwarfs' profit to maximize her welfare, because she gets a fixed proportion of it. So, she sets MR=MC.

$$TR = (100 - Q) \cdot Q \Rightarrow MR = 100 - 2Q;$$

$$TC = 20Q \Rightarrow MC = AC = 20;$$

$$MR = MC \Rightarrow 100 - 2Q = 20 \Rightarrow Q = 40 \Rightarrow$$

$$\Rightarrow \Pi = (p - AC) \cdot Q = (100 - 40 - 20) \cdot 40 = 1600;\ 0.1\Pi = 160$$

The dwarfs produce 40 diamonds and Snow White gets \$160 from them.

ii. Suppose now that the dwarfs are greedy and will produce diamonds as long as the production of an additional one gives nonzero profit. How much money will Snow White get from them now? What is the economic intuition behind the result in terms of externalities? What is the intuition in terms of competitive markets?

$\Pi = (p - AC) \cdot Q = 0 \Rightarrow p = AC$ ***- the dwarfs will produce the diamonds until*** $p = AC = \$20$***. Evidently, they produce 80 diamonds then, make zero profit and Snow White has nothing to eat. The intuition in terms of externalities is that when each dwarf decides whether to produce an additional diamond or not, he does not take into account the losses of others, which will result from the price decline this additional production brings about. This is the tragedy of commons. The intuition in terms of competitive markets is the Bertrand story. The dwarfs compete and each of them is ready to undercut all others and grab the whole market if it brings any profit to do so. Nobody will undercut only if*** $p = AC = \$20$***, because the undercutting brings negative profit then.***

Notice that the tragedy of commons logic shows that the assumption that the undercutter grabs the whole market is not necessary to do away with collusion. Notice also that while the firms in a competitive market suffer from the tragedy of commons, this manifestation of the tragedy is beneficial to the society, because the consumers benefit from the lack of coordination between the firms.

iii. Suppose now that Snow White can cook tasty food, make dwarfs' home cozy and take other actions to raise their opportunity costs of production (that is, each dwarf will act as if it cost $C > \$20$ to produce a diamond, but this increase in costs will not be reflected in profits). How high should Snow White make the costs in order to get as much money as in (i)?

Hint: What you have to do is to find cost C (per diamond produced), facing which dwarfs will produce in (ii) as many diamonds as they produce in (i) facing cost \$20 per diamond.

Snow White wants the dwarfs to produce 40 diamonds. She knows that the greedy dwarfs will set $p = AC$, so all she needs is to raise their AC to \$60. The dwarfs will again bring home \$1600 and give \$160 to Snow White. If the dwarfs want to stay at home, but still have to go to work, they can treat the positive monetary ***profit from working as a fair compensation for being torn away from home (and think they get zero*** economic ***profit, for example). For Snow White, the monetary profit is simply money on the table, because she is self-interested.***

<u>Remark</u>: The increase of \$40 in the opportunity cost, which Snow White initiated, helped to overcome the tragedy of commons and get back to positive profits. In general, it is usually referred to as Pigouvian tax. The point of it is that after AC increased, each dwarf began to internalize, in a way, the losses of other dwarfs he caused before by excess production of the diamonds.

iv. What is the loss/gain to diamond buyers as the dwarfs switch from their behavior in (ii) to their behavior in (iii)? What is the loss/gain to the society (the reduction/increase of total welfare of the diamond buyers, the dwarfs and Snow White)? Assume that only monetary benefits count.

You can easily verify that in (iii) $CS_{(iii)} = 0.5Q^2_{(iii)} \Rightarrow CS_{(iii)} = 800 = 0.5\Pi_{(iii)}$***. It happens because the slope of the demand function is -1. So,*** $SW_{(iii)} = \$800 + \$1600 = \$2400$***, because only monetary benefits count.*** $SW_{(ii)} = CS_{(ii)} = 0.5Q^2_{(ii)} = \$3200$***. Hence, both the buyers and the society as a whole are worse off as the dwarfs switch from (ii) to (iii). This is not surprising, since the switch is actually the switch from perfect competition to monopoly.***

v. Suppose diamond buyers know that Snow White can influence dwarfs' behavior and can communicate to her. What would be optimal for them to do?

Hint: Think about the Coase theorem.

The diamond buyers can bribe Snow White not to make the dwarfs' home cozy etc. and let them produce 80 diamonds and bring home zero

profit. Even if we assume that making the dwarfs' home cozy etc. costs nothing to Snow White, she will surely refrain from doing so if the diamond buyers offer her \$161 for not doing it. The buyers will get \$3200-\$161=\$3139, which is way better than \$800 they get in (iii).

You may notice that even if Snow White and the dwarfs acted together as a monopoly, the diamond buyers can still bribe them all to produce 80 diamonds by paying them \$1601 and leaving \$3200-\$1601=\$1599>\$800 to themselves. The reason why we do not see such things (which would be in line with Coase theorem) in real life is that it is very difficult for all Microsoft Office users, for example, to get together and gather enough money to bribe Bill Gates to do what they want. Also, it will be extremely difficult to them to make sure he does what they ask him to. So, monopoly problems cannot be solved through a Coase-theorem bargaining, because the buyers are dispersed and the transaction costs are not zero (as the theorem assumes), but are prohibitively high.

3 Crime and Punishment

Bret Maverick received some training in finance, which made his utility function equal to the the ratio of expected payoff to the standard deviation of a gamble, that is, his utility from gamble X is now equal to $U = E(X)/\sigma(X)$. But, alas, the training did not change his moral values. When he accepted a position in the industry, he identified at once two fraud opportunities. The first (second) opportunity offered him \$10K (\$38K) payoff and 80% (50%) probability to get away with it. If Bret Maverick gets caught, he suffers a loss of \$25K.

i. Which fraud opportunity is the best for Bret Maverick?

The first opportunity has expected value of $0.8{\cdot}10{-}0.2{\cdot}25 = 3$ ***and standard deviation of*** $\sqrt{0.8 \cdot (10-3)^2 + 0.2 \cdot (-25-3)^2} = 14$***. Maverick's utility from undertaking it is*** $3/14 \approx 0.21$***.***

The second opportunity has expected value of $0.5 \cdot (38 - 25) = 6.5$ ***and***

standard deviation of $\sqrt{0.5 \cdot [(38 - 6.5)^2 + (-25 - 6.5)^2]} = 31.5$***. Maverick's utility from undertaking it is*** $6.5/31.5 \approx 0.2$***. So, Maverick will choose the first opportunity.***

ii. Suppose Bret Maverick's boss Commodore Duvall offers him \$500 fair play bonus: if Bret Maverick does not commit any fraud, he will get the bonus for sure. What will Bret Maverick do?

Maverick will accept Commodore's offer, since its payoff has zero standard deviation. Hence, Maverick will get infinite utility from the offer, i.e., it is better for him than any gamble.

iii. Suppose now that Commodore offers Maverick nothing, but Bret Maverick's old friend Chief Joseph tempts him to go for a few dollars more and offers him an additional fraud opportunity. The additional fraud can be committed only together with Maverick's choice from (i). It will increase both possible gain and possible loss of Maverick's choice from (i), but will leave its expected gain unchanged. Will Bret Maverick commit the additional fraud? (Do not perform any calculations)

No, he won't. Joseph's offer increases the standard deviation of Maverick's best gamble and offers no compensation for it (leaves expected payoff unchanged).

4 Externalities, Property Rights, and Fiscal Illusion

Chief White Halfoat plans to build a wigwam. The value of the wigwam to Chief White Halfoat equals to the level of effort he exerts during production. The cost of level of effort x are $0.25x^2$. The local authorities can vindicate the wigwam from Chief White Halfoat (e.g., to search oil under the wigwam) for a certain price and he cannot reject the offer or bargain. The benefits to the society from taking over Chief White Halfoat's wigwam with probability p are equal to $0.5 \ln p$. Both local authorities and Chief White Halfoat are risk-neutral.

i. Suppose that local authorities can give orders about the effort to Chief White Halfoat and try to maximize the (expected) social welfare, which is equal to $0.5 \ln p + (1 -$

$p) \cdot x - 0.25x^2$ (benefits to the society from taking over the wigwam plus expected value of the wigwam to Chief White Halfoat (given the probability of vindication) minus his costs of building it he incurs anyway, since he does not know if the wigwam will be vindicated or not when he builds it). Find the optimal level of Chief White Halfoat's effort and the optimal probability of vindication.

Hint: Note that the social welfare does not depend on the price Chief White Halfoat will receive for his wigwam, since it is just a transfer from local authorities to Chief White Halfoat, i.e., the decision on the price neither creates nor destroys value.

$$\max_{x,p}\{0.5\ln p + (1-p)\cdot x - 0.25x^2\} \tag{1}$$

$$\begin{cases} \frac{1}{2p} - x = 0 \\ 1 - p - \frac{x}{2} = 0 \end{cases} \Rightarrow \begin{cases} \frac{1}{2p} = x \\ 4p(1-p) = 1 \end{cases} \Rightarrow \begin{cases} \frac{1}{2p} = x \\ (2p-1)^2 = 0 \end{cases} \Rightarrow \begin{cases} p = \frac{1}{2} \\ x = 1 \end{cases}$$

ii. Suppose now that local authorities can give no orders to Chief White Halfoat and there is a law, which requires that local authorities pay the full value of the wigwam if they choose to vindicate it. (Assume that the value is observable to local authorities). What are the optimal values of Chief White Halfoat's effort and probability of vindication? How do they compare to the socially optimal values? Why? (Think in terms of externalities).

Hint: First, compute the optimal value of Chief White Halfoat's effort given that he gets the value of the wigwam and spends the effort for sure. Then maximize social welfare with respect only to the probability of vindication.

Chief White Halfoat solves: $\max_x(x - 0.25x^2) \Rightarrow 1 - 0.5x = 0 \Rightarrow x = 2$

Local authorities solve: $\max_p\{0.5\ln p + (1-p)\cdot x - 0.25x^2\} \Rightarrow 1/2p - x = 0$

We know already that $x = 2$***, so we can substitute the value of*** x ***in local authorities' FOC and get that*** $p = 0.25$***.***

Notice that Chief White Halfoat gets the full benefit from his wigwam does not matter if it is vindicated or not. He exerts more effort than is required to achieve the social optimum, because he does not care about the benefits of the society and thus does not take into account the fact

that it is sometimes socially optimal to vindicate his wigwam. Speaking in terms of externalities, his too elaborate wigwam is a negative externality on local authorities. They are not able to implement some socially optimal projects requiring the vindication, since Chief White Halfoat's effort has made the costs of vindication too high. Hence, local authorities vindicate the wigwam less often than in the social optimum.

iii. Finally, suppose that the local authorities cannot observe the value of the wigwam and are afraid that Chief White Halfoat will name an extremely high value if he is asked about it. So, they decide to offer him a fixed compensation of 3/4 he cannot reject. Moreover, the local authorities now suffer from fiscal illusion: they have the same benefits from vindication the society has, but think that the only cost of vindication is the (expected) price they pay to Chief White Halfoat. Find the optimal values of Chief White Halfoat's effort and the probability of vindication in this case. Compare them with the results from (i) and (ii). What causes the difference? (Think again in terms of externalities). What is the fixed value of compensation local authorities should offer to get the socially optimal value of effort and probability of vindication even under fiscal illusion?

    Hint: Proceed the same way you did in (ii), but now start with maximizing local authorities' welfare, which now consists of the social benefits of vindication and the expected value of the compensation. Find the optimal probability of vindication. Then maximize Chief White Halfoat's welfare, assuming the probability unknown.

    Local authorities solve: $\max_p \{0.5 \ln p - 0.75p\} \Rightarrow 1/2p - 0.75 = 0 \Rightarrow p = 2/3$

    Chief White Halfoat solves: $\max_p \{(1-p) \cdot x + 0.75p - 0.25x^2\} \Rightarrow 1 - p = 0.5x$

    We know already that $p = 2/3$***, so we can substitute the value of*** p ***in Chief White Halfoat's FOC and get that*** $x = 2/3$***.***

    Now Chief White Halfoat has socially optimal incentives (his FOC is the same as the FOC with respect to x ***in (i)), because he benefits from his effort only when the wigwam is not vindicated. However, local authorities suffer from fiscal illusion and do not appreciate Chief White Halfoat's effort, which increases social welfare (and the costs of vindication from the point of view of society). So, they vindicate too often***

and create negative externality for Chief White Halfoat, who has to give up his wigwam too often and hence is discouraged to exert effort while building it.

Since the size of the compensation does not influence Chief White Halfoat's incentives and they are socially optimal, we can reach social optimum by raising the compensation and making the local authorities internalize the costs of vindication to society (negative externalities of vindication to Chief White Halfoat) this way. In particular, if we set the compensation to the socially optimal level of effort, the social optimum will be reached.

The reasoning is as follows: FOC with respect to p ***in (i) is*** $1/2p - x^* = 0$***, where*** x^* ***is the socially optimal level of effort***. ***We know from (i) that*** $x^* = 1$***. In our case, the local authorities' FOC is*** $1/2p - C = 0$, ***where*** C ***is the compensation. So,*** $C = x^* = 1 \Rightarrow p = 1/2$ ***under fiscal illusion as well.***