Econ 131
Spring 2022
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Midterm Exam Solution

1. True/False/Uncertain (Questions 1a-e) (15 points, 3 points per question.)

Explain your answer fully based on what was discussed in class, since all the credit is based on the explanation. Your grade depends entirely on the substance of your justification, not on whether you are correct in writing "True" or "False". Note that it is possible to answer each question for full credit with three sentences or fewer, and answers longer than ten lines long will not be graded.

(a) Labor supply theory and changes in incentives do a pretty good job at explaining the labor force participation of single mothers in the US over the last four decades.

UNCERTAIN: it is true that the surge in labor force participation of single mothers in the US in the 1990s coincided with welfare reform and the expansion of the Earned Income Tax Credit. The old literature believed that the EITC was the key element but recent work by Kleven (2019) has cast doubt on this: other EITC expansions did not increase LFP of single mothers. Hence, it is likely that a combination of EITC, welfare reform, and changes in social norms explain the surge in the LFP of single mothers.

(b) Taxes cannot have a very large impact on labor supply of prime age workers because France has much higher taxes than the US and yet about the same work rate among prime age workers.

TRUE: France has much higher taxes than the US and yet about the same work rate among prime age workers. This is suggestive that taxes do not have a large impact along the extensive margin but it does prove it for sure. For example, maybe France has higher labor force participation of women because it has more extensive public child care and pre-kindergarten schooling than the US. It is also still possible that taxes could have an impact on the intensive margin so just this simple piece of evidence is not conclusive.

(c) The theory of optimal commodity taxation argues that tax rates should be set equal across all commodities, in order to maximize efficiency through "tax smoothing".

FALSE: The efficiency costs of commodity taxation depend on the size of the elasticities of supply and demand for each good. Hence, it is more efficient to have higher tax rates on inelastic goods. Equal tax rates across all commodities is desirable only if elasticities are the same across goods.

(d) Evidence from changes in the Value Added Tax in Europe shows that the price of goods or services rises by the full amount of the value added tax. Therefore, consumers are bearing the full burden of the value added tax.

TRUE/FALSE: It is true that the price of goods or services rises by the full amount of the value added tax increase (see the Benzarti et al. study we covered in lecture). In the standard model of tax incidence, this indeed implies that consumers are bearing the full burden of the value added tax. However, the same study by Benzarti et al. also shows that, when there is a VAT decrease, the price falls by less than the full amount of the value added tax cut. This asymmetry contradicts the standard model of tax incidence. Therefore, we cannot use the standard model of tax incidence to conclude about the tax incidence of value added tax and it is not quite clear who bears the burden on value added tax.

(e) Even though top marginal tax rates for the individual income tax were very high in the 1950s in the US, the tax system overall wasn't very progressive because very few taxpayers were paying these very high marginal tax rates.

TRUE/FALSE: It is true that very few taxpayers were paying the very high top marginal tax rates on the 1950s. Nevertheless, the overall tax rates on the super rich were very high in the 1950s (see Saez and Zucman 2019 graph on overall tax rates by income group and by decade).

2. Incidence of Commodity Taxation (5 Points)

Consider the following model for the crunchy corn puff snack Cheetos market at the Golden Bear Café. Suppose the demand for Cheetos at the Golden Bear Café is given by $Q^D = 300 - 40P$, where P denotes the price and Q denotes the quantity of Cheetos demanded. The supply for Cheetos is given by $Q^S = 20P$.

(a) Compute the Cheetos market equilibrium. What are the equilibrium price and quantity? *(1 Point)*

Equating supply and demand functions and solving for the equilibrium price yields:

$$300 - 40P = 20P$$
$$P^* = 5 \ , \ Q^* = 100$$

(b) Now suppose a tax of $t = \$3$ is imposed on each Cheetos that is purchased. Compute the Cheetos market equilibrium with the tax. What are the equilibrium price and quantity? *(1 Point)*

Remember that it does not matter who bears the statutory incidence of the tax. Therefore, without loss of generality, we add the tax to the supply side and solve for the post-tax consumer price:

$$300 - 40P = 20(P^C - 3)$$
$$60P^C = 360$$
$$P^C = 6, \ Q^* = 60$$
$$P^S = 6 - 3 = 3$$

The quantity exchanged in the market fell to 60 Cheetos, the price producers face is now \$3 and the price consumers now face is \$6.

(c) **Compute** and **graphically** depict deadweight loss due to the tax. *(2 Points)*

Deadweight loss is represented by a triangle. Its height is the tax of \$3 and its base is the distortion in the quantity exchanged: 100-60=40 units.

$$DWL = (40 \times 3)/2 = \$60$$

(d) What is the incidence of the tax? **In 5 sentences or less**, explain the intuition for the key factors that determine the incidence. *(1 Point)*

Out of the \$3 tax, \$1 are born by consumers and \$2 by producers, therefore 33% or one third is on the demand and 66% or two thirds on the supply. The more inelastic side bears the largest incidence. In this case, as you can see from the relative slopes, the supply side is more inelastic than demand.

3. Labor Income Tax (10 Points)

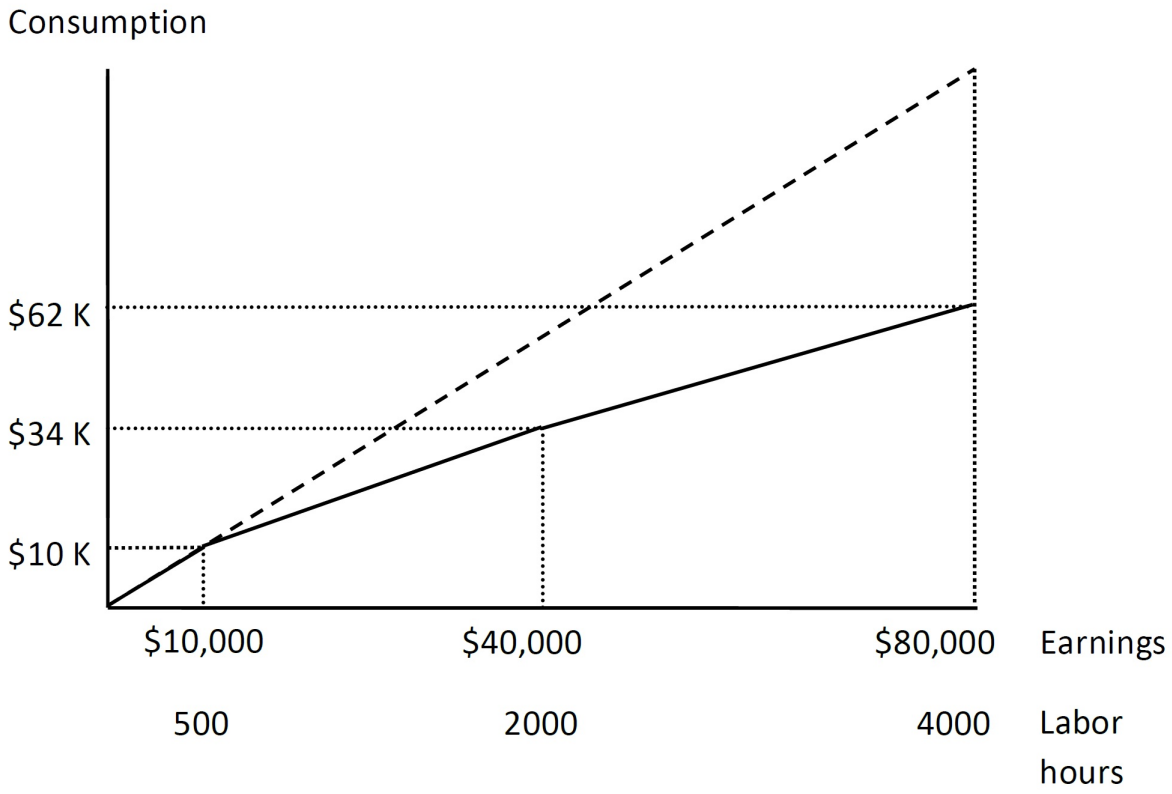
Alexey is a graduate of UC Berkeley who took a job at a local consulting firm with a wage of \$20 per hour. The job is extremely flexible: Alexey is allowed to work any number of hours from 0 to 4000 per year. His preferences over aggregate consumption, c, and labor, ℓ, are represented by the following quasi-linear utility function:

$$\mathcal{U}(c, \ell) = 100c - \frac{\ell^2}{2}$$

(a) Suppose that as soon as Alexey had taken the job, the government switched to the following progressive income tax system:

- Income up to \$10,000: no tax
- Income between \$10,000 and \$40,000: 20% tax rate
- Income above \$40,000: 30% tax rate

Draw a graph in consumption (c) / pre-tax income ($z = w\ell$) space showing Alexey's opportunity set with and without the new tax system. How many hours Alexey would need to work to reach pre-tax income \$10,000? How many hours to reach pre-tax income \$40,000? *(3 Points)*



(b) For each level of pre-tax income, determine the sign of the income effect, substitution effect, and total effect of the reform compared to a baseline with no taxes, and fill in the following table. Use ↑ to indicate if the an effect incentivizes work, ↓ if it disincentives work, 0 is there is no effect, and ? if the effect is uncertain.
(2 Points)

Pre-Tax Income	**Income effect**	**Substitution effect**	**Total Effect**
Below \$10,000	0	0	0
Between \$10,000 & \$40,000	↑	↓	?
Above \$40,000	↑	↓	?

(c) Solve for Alexey's optimal choice of labor under no tax and under the new tax system. Please explain your reasoning and discuss whether your result here is in line with your answer in (b). *Hint: you can use any method of optimization discussed in class.*
(3 Points)

Given the piece-wise budget constraint induced by the new tax system, Alexey's optimization problems is

$$\max_{c,\ell} \quad \mathcal{U}(c,\ell) = 100c - \frac{\ell^2}{2}$$

subject to the following constraints:

$c = 20\ell$ if $0 \leq \ell \leq 500$;

$c = 10,000 + 16(\ell - 500)$ if $500 \leq \ell \leq 2,000$;

$c = 34,000 + 14(\ell - 2,000)$ if $2,000 \leq \ell \leq 4,000$;

To solve this non-linear budget constraint optimization problem, optimize on each part of the budget constraint separately, pretending that this budget constraint applies for all levels of ℓ. Graphically, extend out each segment to zero and infinity and pretend that the budget constraint is just that line in each case. We will use the equimarginal principle to solve for optimal ℓ^* in each case, thus equating the marginal rate of substitution (MRS) to the price ratio. Notice that since the optimization problem is expressed in terms of consumption and labor, the wage enters with the negative sign:

$$\frac{MU_c}{MU_\ell} = \frac{1}{-w_{net}},$$

where $w_{net} = 20(1 - \tau_i)$ and τ_i is the marginal tax rate in income tax bracket i.

The MRS in each segment is equal to $-100/\ell$. The price ratio in the first bracket is $-1/20$, hence Alexey would choose to work $2,000$ at this marginal rate. However, the maximum number of hours Alexey can work and still be on the first segment of the budget constraint is $\$10,000/\$20 = 500$ hours, so this solution is **not feasible**. The price ratio in the second bracket is $-1/(20(1-0.2)) = -1/16$. Therefore, the optimal labor provision in this case is $\ell^* = 1,600$, and the corresponding pre-tax income is $1,600 * \$20 = \$32,000$. Note that this solution is **feasible** because $\$32,000 < \$40,000$. Finally, the price ratio in the third and final bracket equals to $-1/(20(1-0.3)) = -1/14$. Therefore, the optimal labor provision in this case is $\ell^* = 1,400$, and the corresponding pre-tax income is $1,400 * \$20 = \$28,000$, which is below the pre-tax income threshold of $\$40,000$. Therefore, this solution is **not feasible**.

Finally, we conclude that the new tax system dicourages Alexey from working. Before the change in the tax system, he chose to work $2,000$ hours at \$20 wage, thus making $\$40,000$. After the new tax system was introduced, Alexey reduced his optimal labor provision to $1,600$ hours, and his total pre-tax income thus went down to $\$32,000$. Since in the second income tax bracket the substitution effect discourages labor and the income effect encourages it, we conclude that the substitution effect is larger in magnitude in this case.

(d) Suppose now that the 30% marginal tax rate starts at \$30,000 instead of \$40,000. How many hours will Alexey choose to work now? *(2 Points)*

If the top tax bracket – 30% – shifts down to $\$30,000$, we perform the same maximization as in part (a) but with the new budget constraint. If Alexey faces a 20% marginal tax, he would want to work $1,600$ hours, which results in a gross pre-tax income of $\$32,000$. Now, his optimal earnings are too high for him to remain in middle income tax bracket. At a marginal tax rate of 30% Alexey would choose to work $1,400$ hours, thus making $1400 * \$20 = \$28,000$ in pre-tax earnings. This amount now is too low for Alexey to remain in the top tax bracket. Therefore, Alexey will bunch at the convex kink between income tax bracket 2 and top income tax bracket, working exactly $\$30,000/\$20 = 1,500$ hours.