

# Problem Set 8

PPHA 32300 Microeconomics and Public Policy I  
Fall 2025

## Instructions

- (i) This problem set is due **Thursday, December 4, at 11:59pm CT**.
- (ii) This problem set is divided into two parts:
  - Part I includes *ungraded* practice problems that students can optionally complete to deepen their understanding of the material. **Do not submit your answers.**
  - Part II includes *graded* problems. **You have to submit your answers.** You are allowed to collaborate in small groups for this part. However, **each student must submit their own individual write-up.** Your submission should reflect your personal understanding of the material, and therefore must be written in your own words. Please show your work, including calculations and clear, legible diagrams.
- (iii) **Submit Part II electronically on Gradescope as a PDF:**
  - You may use a scanner, or a scanning app, or a tablet, or any other method of generating a PDF.
  - In the event that you don't have a scanning app, we recommend Adobe Scan – it's free.
  - Ensure that your submission includes all pages and that each page corresponds correctly to the appropriate question and answer.
  - Each improperly tagged question will be subject to a penalty equal to 10% of the question's value.

## Part I: Practice Problems (Do NOT submit answers)

1. Dilla's hourly wage has increased from \$25 to \$30 per hour. Previously, he was working 9 hours a day, and now he is working 10 hours a day. Can we conclude that a positive substitution effect on working hours has outweighed a negative income effect on working hours?

No. When wages increase, there are both substitution and income effects. The substitution effect on working hours will be positive, but the income effect can be positive or negative, depending on whether time spent at home (leisure) is an inferior or normal good. We can conclude that the total effect is positive, but we do not know whether the income effect was positive or negative.

2. Briefly explain why a lump-sum government **transfer** (i.e. the opposite of a lump-sum tax) can induce some workers to stop working, while the **earned income tax credit** (i.e. a refundable tax credit designed to support low- to moderate-income workers so they effectively have higher wage rates) can induce some people who otherwise would not work to start working.

A lump-sum transfer is associated with an income effect but not a substitution effect because it doesn't affect the wage rate. Thus, if leisure is a normal good, a lump-sum transfer will likely cause workers to work fewer hours while possibly enticing some workers to exit the labor force altogether. On the other hand, the earned income tax credit (EITC) raises the effective wage of low-income workers by 40%, at least for the poorest workers. Thus, someone who had not been working faces a wage that is 40% higher than it otherwise was. This increase may be enough to encourage the person to start working. Furthermore, the EITC cannot encourage workers to exit labor force, as the benefits of the EITC are received only by workers.

3. Which of the following statements about a labor market are correct? Select *all that apply*.
  - (a) A proportional tax on hourly wages may create both an income effect and a substitution effect on working hours.
  - (b) An increase in non-labor income (e.g., inheritance) can reduce the labor supply.

- (c) Labor supply curve is always upward sloping.
- (d) Lump-sum taxes are regressive, meaning they take a larger proportion of income from low-income earners.
- (e) Lump-sum taxes result in a greater welfare loss than proportional taxes on wages for the same tax revenue.

(a) is correct. The substitution effect makes leisure relatively cheaper, encouraging less labor supply, while the income effect may encourage more labor to compensate for lost income.

(b) is correct. Non-labor income increases overall income, leading to an income effect that reduces labor supply if leisure is a normal good.

(c) is incorrect. Labor supply curve can bend backward if the income effect dominates the substitution effect at higher wage levels. Think about the case when the hourly wage is as high as \$1M; you might want to work less instead...

(d) is correct. Since lump-sum taxes are a fixed amount, they represent a higher percentage of income for lower-income individuals.

(e) is incorrect. Lump-sum taxes are efficient because they do not distort labor supply decisions, while proportional taxes create excess burden (i.e. deadweight loss).

## Part II (Submit your answers)

For each of the answers below, make a good faith attempt to answer each question and sub-question to the best of your ability. Provide complete answers and show your work, including explanations and derivations where appropriate. Failure to explain your answers or show your derivations may be penalized.

1. (20 points) In this question, we'll look at the impact of some of the provisions of the One, Big, Beautiful Bill (OBBB) on a specific worker, who will experience a decrease in both her income tax rate as well as benefits from public aid programs.

Jasmine's preferences for consumption and leisure can be expressed as

$$U(c, h) = (c - 200)(h - 80)$$

where  $c$  is her consumption of goods and services and  $h$  is the number of hours spent at home. The price of  $c$  has been normalized to  $p_c = 1$ . She has 168 hours in a week available to split between work and leisure. She earns \$12 per hour before taxes.

She is enrolled in Medicaid and the Supplemental Nutritional Assistance Program (SNAP) and draws benefits worth \$270 per week\*.

- (a) (2 points) For Jasmine, what is the marginal utility of consumption? What is the marginal utility of leisure?

In the absence of the OBBB, Jasmine's marginal tax rate would be 15%, reducing her post-tax wage to  $\$12 \times (1 - 0.15) = \$10.2$ .

- (b) (4 points) Derive Jasmine's budget set, and graph it. Put consumption (in dollars)  $c$  on y-axis, and hours spent at home (i.e. leisure)  $h$  on x-axis. Also indicate the  $c$ -intercept,  $h$ -intercept, and the kink on the graph.
- (c) (2 points) Solve for the tangency condition at optimal bundle  $(c^*, h^*)$ . (Hint: The answer should be expressed as  $c^* = ah^* + b$ . What are the values of  $a$  and  $b$ ?)
- (d) (3 points) Based on the results in the previous questions, solve for Jasmine's optimal bundle of consumption and leisure. In each case, you may round to the nearest dollar or hour, respectively. How many hours a week does she work?

The OBBB has two effects on Jasmine. First, it effectively reduces her tax rate from 15% to 10%<sup>†</sup>. This raises her post-tax wage to  $\$12 \times (1 - 0.1) = \$10.8$ .

Second, it reduced funding for Medicaid and SNAP. We will model such change as a \$40 reduction in her non-labor income<sup>‡</sup>. Her non-labor income therefore falls to  $\$270 - \$40 = \$230$ .

- (e) (3 points) Given these changes to her wages and non-labor income, find the new budget con-

\*Medicaid costs \$900 billion per year, and covers \$78 million individuals, averaging \$221 per individual per week. The benefits from SNAP are approximately \$240 per household per month, which is \$52 per week. For simplicity, we're rounding down and ignoring SNAP's phase-out.

<sup>†</sup>The OBBB made permanent tax cuts from the Tax Cuts and Jobs Act of 2017, which would have otherwise expired this year. This act raised the threshold above which an individual is taxed from \$6,350 to \$12,000. By doing so, it moves Jasmine from the 15% marginal income tax bracket to the 10% marginal income tax bracket. For simplicity, we will ignore the additional kinks introduced by the progressive tax system, though you are welcome to and model them!

<sup>‡</sup>Medicaid funding was reduced by approximately 13%, which is \$29 of \$221. Funding for SNAP was reduced by approximately 19%, which is \$10 of \$52. For simplicity, we're ignoring state responses and rounding up to \$40.

straint and tangency condition.

- (f) (3 points) Solve for Jasmine's new optimal bundle of consumption and leisure. You may round to the nearest dollar or hour, respectively. How many hours a week does she work? What is her new consumption level?
- (g) (3 points) Is Jasmine better off or worse off under the OBBB? Provide a brief analysis of how it affected her. You may assume that both consumption and leisure are normal goods. (*Hint: Use her utility function to rank the pre- and post-OBBB bundles.*)

2. (25 points) Bruno is a musician. Every week, he decides how many hours to spend at home ( $h_B$ ) and how many hours to work ( $L_B$ ). He spends the money he earns while working on consumption ( $c_B$ ). He has 112 hours per week that can be spent at home or working, and he has no source of non-labor income. Bruno's preferences over time at home and consumption are represented by the following utility function:

$$U(c_B, h_B) = c_B + 1,500 \times \ln(h_B),$$

where " $\ln$ " is the natural logarithm function. The price of a unit of consumption is \$1.

- (a) (2 points) Write down Bruno's budget constraint, in terms of consumption ( $c_B$ ) and time at home ( $h_B$ ) and a wage  $w$ .
- (b) (5 points) Derive Bruno's labor supply function  $L_B(w)$ . Suppose that Bruno is paid a wage of  $w = 30$  per hour. How many hours will he work? (Hint: with a function  $f(x) = a \times \ln(x)$ , the derivative will be  $\frac{\partial f}{\partial x} = \frac{a}{x}$ .)
- (c) (2 points) Charlie is also a musician. Like Bruno, he has 112 hours per week to spend on either time at home or working. Charlie does receive a pension of \$300 per week, no matter how much he works. Write down Charlie's budget constraint as a relationship between consumption ( $c_C$ ), time at home ( $h_C$ ), his wage  $w$ , and his non-labor income ( $Y_C = 300$ ).
- (d) (4 points) Suppose Charlie has preferences over time at home ( $h_C$ ) and consumption ( $c_C$ ) represented by the following utility function:

$$U(c_C, h_C) = c_C \times h_C$$

How many hours will Charlie work at a wage of  $w = 20$ ?

- (e) (2 points) As a result of a copyright settlement, Bruno must pay one-third of his earnings to Charlie. Bruno keeps the rest. Write down Bruno's new budget constraint, in terms of time at home ( $h_B$ ) and consumption ( $c_B$ ) and his wage  $w$ .
- (f) (4 points) Suppose Bruno's wage is still  $w = 30$ . Show that his settlement payment to Charlie will be \$370.
- (g) (2 points) After the settlement, what is Charlie's new budget constraint in terms of consumption ( $c_C$ ) and time at home ( $h_C$ ), his wage  $w$ , and non-labor income ( $Y_C = 300$ ) and his settlement payment?
- (h) (4 points) What will be Charlie's new level of labor supply after the copyright settlement? Charlie's wage is still  $w = 20$ .
- (i) (0 points) Define the income elasticity of labor supply as:

$$E_L^Y = \frac{\% \Delta L}{\% \Delta Y}$$

Calculate Charlie's income elasticity of labor supply. (This is another ungraded practice question that may be asked in the final. As before, no calculus is required, just consider the change in behavior.)