Department of Economics
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EAE-1234 - Public Economics
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Exercise list 2
2nd semester 2024

Instructions: The exercise list can be solved in group (maximum 4), but each member has to **write** and deliver the list separably. When solved in group, please note the group participants. Exercise lists "copy and pasted"will be punished as defined in the syllabus.

1. **(Taxation and risk)** Maria has an income of R$1000, which she must decide between using for consumption or to start a business. Imagine that she can invest a share q of that income, namely R$\$1000q$, in her business, which might be successful and pay R$\$3000q$, or it might fail and pay zero, both with equal likelihood.

   All potential profit plus the income not invested are immediately consumed. Maria's risk preferences are represented by von Neumann-Morgenstern preferences given by

   $$U(w) = \mathbb{E}[\ln w].$$

   (a) What is the share q of her income that Maria invests in her new business?

   (b) Consider now that the government created a tax on capital income of 20%, with full tax loss offset. What is now the share of her wealth that Maria invests? Interpret.

   (c) What if there is no loss offset? Interpret.

   (d) In the real world, governments often allow for tax loss offset, but only until the tax liability reaches zero. Consider a tax on Maria's income of 5% beyond the capital tax in (b), but now the capital tax has tax loss offset only until Maria's tax liability reaches zero. Solve for Maria's optimal investment decision.

   (e) Consider now an economy without capital income tax, but with a progressive (comprehensive) income tax of 20% up to R$1000 and 40% beyond that amount. Compute the optimal share q invested and interpret.

2. **(Corporate taxes)** A small company in the food processing industry operates with a production function

   $$Q^S = f(K, L) = 10\sqrt{\min\{K, L\}},$$

   where K is measured in machines/year and L in worker hours. Consider that wage per hour is $w =$ R$\$500$, the rental price of one machine is v and that the firm is a price-taker, with the price of the final product being $P =$ R$\$600$.

   The machines used for production are industrial ovens that cost R$10,000 each, and the firm's financing cost is 10% a year. Assume for simplicity that the ovens last forever.

   (a) What is v? Compute the total cost function and the profit function of the firm.

   (b) What is the optimal production quantity by the firm and its demand for capital and labor?

(c) Now consider that the government implements a corporate tax of $\tau = 20\%$ over the company's revenue, with complete deduction of capital costs and wages. Does this corporate tax affect the optimal production and input use of the firm? Calculate and explain. What is the government revenue, and how does this tax relate to a tax on economic profits?

(d) In the real world, governments rarely know the firms' true cost of financing, and deduce costs of capital at a fixed depreciation allowance. Imagine that this rate is 5%. What happens to the demand for capital and labor, quantity produced and the company's profit?

(e) Compute the effective corporate tax rate for the taxation in item (d).

3. **(Unemployment insurance)** An economy is composed of identical individuals who earn R$200 when working and zero otherwise. When unemployed (which happens with probability q), they earn an unemployment insurance of b reais from the government. This insurance is financed by a proportional payroll tax τ paid by employed workers. Assume that there is no other possible source of income, that agents consume all they earn and that the workers' preferences are represented by an utility function of the form

$$u(c) = c^{1/3}$$

(a) Write the workers' expected utility as a function of q, b, and τ.

(b) What is the government budget constraint when implementing an *actuarially fair* unemployment insurance program? Write τ as a function of benefits b and unemployment probability q.

(c) Given this *balanced budget* policy, find the benefit level b that maximizes workers' expected utility as a function of unemployment risk q. What is the payroll tax τ that makes such a benefit possible? In this optimal policy, to how much unemployment risk are the workers exposed? Explain intuitively.

(d) Assume that $q = 5\%$. What is the workers' expected utility without unemployment insurance? And with the balanced budget optimal unemploymet insurance? Represent these results graphically.

(e) Now assume that the unemployment probability q depends on the effort the workers employ while working, which depends on the desutility of losing their job (a function of b). This is an example of *moral hazard*. What is going to be the sign of dq/db? Why?

4. **(Social security)** Consider an economy with three types of workers (with the same population), all earning R$400 in wages when they work, but zero in case of a work accident. Each type suffers a work accident with probability q_k, they consume (c) their entire income, and

they can buy private insurance by a price p in a perfectly competitive market. Each type has a different risk q_k and preferences represented by an utility function u_k, namely:

Type 1: $q_1 = 0.4$, $U_1 = \sqrt{c}$
Type 2: $q_2 = 0.1$, $U_2 = \sqrt{c}$
Type 3: $q_3 = 0.1$, $U_3 = c$

(a) All individuals benefit from insurance? Explain.

(b) Assume that workers' types are observable (say, gender or age). What is the profit (as a function of price) that the insurers get from each worker type? What is the price charged from each worker?

(c) In the rest of this exercise, assume that types are not observable. Calculate the *willingness to pay* of each worker type for insurance. What is the (long run) equilibrium market price and who is insured in equilibrium?

(d) How could the government increase efficiency in this sector?

(e) Consider now that workers of type 2 (and only them) have preferences represented by a utility function of form $u_2 = \sqrt[4]{c}$. What is the new equilibrium price and who gets insured in equilibrium? What is the intuition for this result?

5. **(Social assistance)** Fatima has decided to work as a driver for an app, and she must choose how many hours per week she will dedicate to this endeavour. Fatima enjoys consumption c, but also treasures spending leisure time (l) with her family. Her preferences are represented by a utility function

$$U(c, l) = \frac{1}{2}\ln(c - 40) + \frac{1}{2}\ln(l).$$

Her wage in this new employment is R$20 per work hour, and Fatima has a maximum of 80 hours per week that she can spend working or in leisure.

(a) What is Fatima's budget constraint? Solve for her optimal consumption and leisure choice.

(b) Now imagine that the government introduces a negative marginal income tax (like the Earned Income Tax Credit in the US) that subsidizes Fatima's labor in R$20 per hour. What is the new choice of consumption and leisure?

(c) What is the direction of the income and substitution effects on the labor supply? Can we tell without any math which must be stronger?

(d) Now consider that Fatima is beneficiary of a social assistance program (like the "Benefício de Superação da Extrema Pobreza"in previous Bolsa Família), which complements her income up to R$500 if she receives less than that amount. What is her optimal labor supply? Does this program generate any inefficiency?

(e) An economist proposes an Universal Basic Income (UBI) program, which gives R$200 to Fatima as a lump-sum transfer. What is Fatima's new optimal choice of labor supply? Will she work less? Does this generate any inefficiency?