Answers

Re-exam in Public Finance - Fall 2019

3-hour closed book exam

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Part 1: Extensive labor supply responses

In the paper "Labor Supply Response to the Earned Income Tax Credit" by Eissa and Liebman (published in the Quarterly Journal of Economics in 1996), the authors investigate the labor force participation effect of the 1986 expansion of the earned income tax credit (EITC) for single women with children. The EITC (in Danish: "beskæftigelsesfradrag") provides a tax credit for eligible individuals with a qualifying child. The size of the tax credit is a function of the individual's earned income as illustrated in the figure below. The figure is a copy of Figure IV from the article, showing the structure of the EITC before the reform and after the reform.

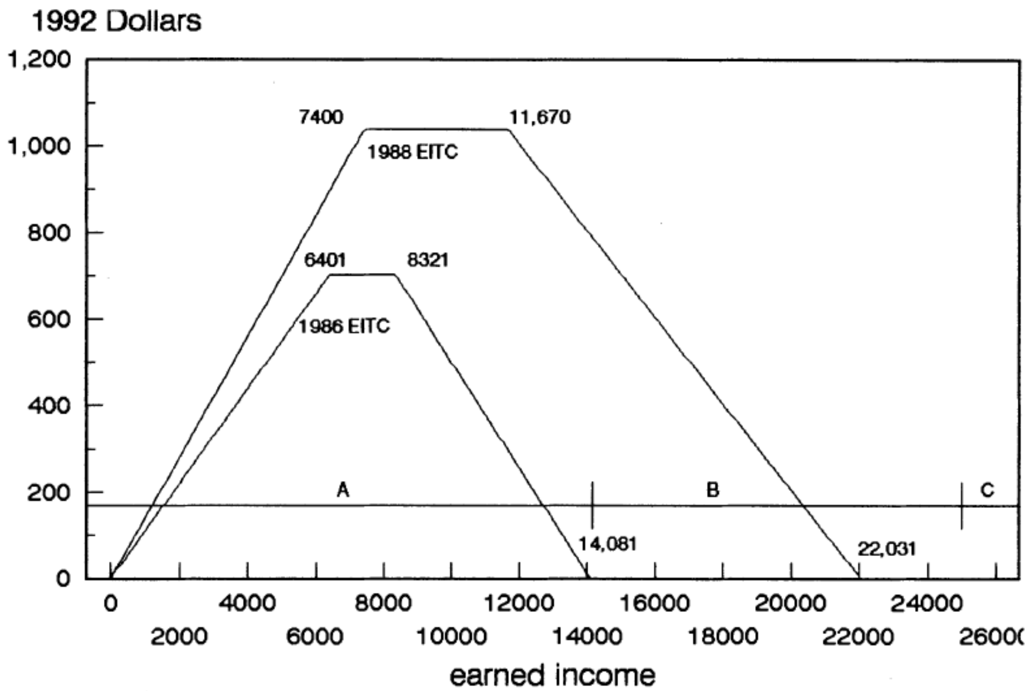

FIGURE IV
1986 and 1988 Earned Income Tax Credit

(1A) *Explain how an EITC may affect labor force participation (i.e. what we may expect theoretically).*

An EITC provides a tax credit for workers depending on their earned income. In the US after the 1986 expansion, the credit was maximized for earned income around 10,000 (1992-USD) and phased out with earnings above that as illustrated on the Figure above. Hence, the EITC lowered the tax burden on low-income earners on the labor market without affecting the disposable income for those outside the labor market. This corresponds to a reduction in the participation tax rate defined as the increase in tax payment and loss of benefits relative to the earnings an individual obtains when entering the labor market. The lower participation tax rate increases the incentive to enter the labor market and (depending on the responsiveness of individuals) increase employment relative to a situation without an EITC (a extensive margin response).

It may be noted that an EITC also affects marginal tax rates differently in different income regions, which also affects the incentives to work on the intensive margin (the number of hours worked conditional on employment).

Eissa and Liebman (1996) use the reform to estimate the impact of the EITC expansion on labor force participation of single women with children. Below is a copy of Table II from the article showing their main estimate.

TABLE II
LABOR FORCE PARTICIPATION RATES OF UNMARRIED WOMEN

	Pre-TRA86 (1)	Post-TRA86 (2)	Difference (3)	Difference-in-differences (4)
A. *Treatment group:*				
With children [20,810]	0.729 (0.004)	0.753 (0.004)	0.024 (0.006)	
Control group:				
Without children [46,287]	0.952 (0.001)	0.952 (0.001)	0.000 (0.002)	*0.024 (0.006)*

(1B) *What is the key estimate in Table II? Describe the empirical analysis and explain how the authors arrive at their estimate.*

Eissa and Liebman (1996) estimate the impact of the EITC expansion using a difference-in-differences (DiD) estimation framework. Using this estimator, they compare the change in outcomes (here labor market participation) for two groups, where one is affected by the reform and one is not. The affected group (treatment group) is single women with a qualifying child, and the unaffected group (control group) is single women without children.

In Table II we see the simple DiD estimation table without controlling for observable characteristics of the two groups. Denote by E_t^i the labor force participation of group i (= **T**reatment or **C**ontrol) at time t (**pre** or **post** reform). Column 1 shows pre-reform labor force participation of the treatment group (top row) and the control group (bottom row). Column 3 shows the time differences of each group

$$E_{post}^T - E_{pre}^T = 0.753 - 0.729 = 0.024$$

$$E_{post}^C - E_{pre}^C = 0.952 - 0.952 = 0.000.$$

Column 4 shows the DiD estimate as

$$\left(E^T_{post} - E^T_{pre}\right) - \left(E^C_{post} - E^C_{pre}\right) = 0.024 - 0.000 = 0.024$$

The estimate of the impact of the reform has the expected sign as the expansion of the EITC seems to have increased the labor force participation of the treatment group.

(1C) *What is the main identifying assumption(s) needed for the estimate to be the causal effect of the EITC on the labor supply of single women with children? Describe the possibilities of validating the assumption(s).*

The DiD estimator only gives the causal effect of the EITC if the common/parallel trend assumption is fullfilled. The common trend assumption states that, in the absence of the reform, the changes in the employment rate of the two groups should be the same. One way to validate if this assumption seems plausible is to consider the evolution of the employment rates of the treatment and control group before and/or after the reform. If the employment rates move in parallel in these years it speaks to the validity of the common trend assumption. More formally this can be tested by running the same DiD estimators in non-reform years. The estimates from these "Placebo tests" should be insignificant.

Part 2: Capital taxation in the short run and in the long run

Consider an economy where firms hire labor (L) and rent capital (K) to produce output (Y) according to the following Cobb-Douglas production function

$$Y = K^{\alpha} L^{1-\alpha}. \tag{1}$$

All markets are perfectly competitive and the wage rate (w^D) and the rental rate (r^D) that firms pay therefore equal the marginal product of labor and capital, respectively. Both labor and capital income are taxed so that the after tax wage rate that workers receive (w^S) and the after tax rental rate that capital capital owners receive (r^S) are given by

$$w^S = (1 - t_L) w^D \tag{2}$$

$$r^S = (1 - t_K) r^D. \tag{3}$$

Finally, assume that workers supply labor according to an aggregate labor supply function $L(w^S)$ with a constant elasticity ε. Log transformation of the equations and total differentia-

tion yields the following five model equations

$$\begin{aligned} \hat{w}^D &= \alpha\left(\hat{K}-\hat{L}\right), && (4)\\ \hat{r}^D &= -\left(1-\alpha\right)\left(\hat{K}-\hat{L}\right), && (5)\\ \hat{w}^S &= \hat{w}^D, && (6)\\ \hat{r}^S &= -\frac{dt_K}{1-t_K}+\hat{r}^D, && (7)\\ \hat{L} &= \varepsilon\hat{w}^S, && (8) \end{aligned}$$

where $\hat{x} = dx/x$ is the percentage/relative change in x. We have also used $dt_L = 0$ since we only focus on changes in the tax on capital.

We distinguish between the effects of a change in the capital tax in the short run and in the long run. In the short run, the capital stock is assumed fixed ($K = \overline{K}$). In the long run, the capital stock is assumed to be perfectly elastic implying that the after-tax rate of return on capital is equal to the exogenous world interest rate level ($r^S = \overline{r}$). Using equations (4)–(8), it is possible to derive the following equations:

$$\hat{w}_S^{Short} = 0\ ,\ \hat{r}_S^{Short} = -\frac{dt_K}{1-t_K}, \qquad (9)$$

$$\hat{w}_S^{Long} = -\frac{\alpha}{1-\alpha}\frac{dt_K}{1-t_K}\ ,\ \hat{r}_S^{Long} = 0, \qquad (10)$$

where superscript "Short" denotes the effects in the short run, while "Long" denotes the effects in the long run.

(2A) *Define the concept of tax incidence.*

In economics, we distinguish between two different types of tax incidence. The formal incidence describes who formally pay a tax to the government. E.g in the case of the VAT, it is formally firms, who pay the tax to the government. However, who actually bears the burden of a tax is described by the economic incidence. In the VAT case, the firms may pass on the tax to consumers by increasing their prices, in which case, the economic incidence is on the consumers. It may be noted that the largest part of the incidence fall on the least elastic side of the market. It may also be noted that the economic incidence ultimately describes the effect of an tax on the utility of different groups in the economy, but to first order the effect on utility can be approximated by the effect of a tax on prices.

(2B) *How do the equations in (9) and (10) inform us about the tax incidence predicted* *by the model? Discuss based on these predictions how a government, who seeks to collect tax revenue from capital owners, will find conflicting incentives in the short and long run.*

Equation (9) shows the short run effect of an increase in the capital tax on the net-of-tax wage rate ($\hat{w}_S^{\text{Short}}$) and rental rate ($\hat{r}_S^{\text{Short}}$) that workers and capital owners recieve. Hence, the equations exactly describe the economic incidence of the tax in the short run, and we see that the is no incidence on workers as their net-of-tax wage is unchanges. Instead the entire incidence is on capital owners.

Looking instead on equation *(10)*, which describes the incidence in the long run, we see that the results flip. In the long run the incidence on capital is zero, while labor bear the full incidence. Hence, a government, who seeks to raise revenue from capital owners, has a short run incentive to increase t_K as the incidence only fall on capital owners, but by during so they effectively do not collect any from capital owners in the long run, where the entire incidence is born by workers. It may also be noted that the tax on capital (in this model) actually end up hurting workers more than if the revenue had been collected by them directly as taxes on labor.

(2C) *Describe the economic intuition underlying the predictions of the model described in question 2B.*

The different economic incidence of the capital tax in the short and long run is driven by the difference in the assumptions about capital mobility, In the short run, the location of capital (in the form of factories etc.) tend do be fixed. Thus, capital owners cannot move their capital away in responce to an increase in the capital tax, but must accept lower net-of-tax profit. As the capital stock is unchanged, so is the marginal product of labor and hence workers' wage rate.

In the long run, the situation is reversed. Over time, factories and machines depreciate and capital owners can choose how much to reinvest. Assuming that capital owners can freely invest aboard (and that the local economy is small), they will choose to reinvest as long as the local net-of-tax rental rate is the same as the global rate. Hence, a higher tax on capital will in the long run reduce the capital stock until the increase in the marginal product of capital (and hence pre-tax rental rate) outweigh the higher tax rate. However, the lower capital stock reduces the capital- labor ratio and hence the marginal product of labor and workers' wage rate.

The above arguments can also be added by a graphical illustration of the capital and labor markets.

(2D) *Show how to derive equations (9) and (10) from the model equations (4)–(8).*

In the short run: $\hat{K} = 0$. Hence by combining (6), (4) and (8) we find

$$\hat{w}^S = \alpha\left(\hat{K} - \varepsilon\hat{w}^S\right) \Leftrightarrow \hat{w}^S\left(1 - \alpha\varepsilon\right) = 0 \Leftrightarrow \hat{w}_S^{\text{Short}} = 0$$

and by combining (7) and (5) with the fact that $\hat{L} = \varepsilon 0 = 0$, we find

$$\hat{r}_S^{\text{Short}} = -\frac{dt_K}{1 - t_K} - (1 - \alpha)\left(\hat{K} - \hat{L}\right) = -\frac{dt_K}{1 - t_K}.$$

In the long run: $\hat{r}_S^{\text{Long}} = 0$, which given equations (7) and (5) implies

$$\hat{r}^D = \frac{dt_K}{1 - t_K} \Rightarrow \frac{dt_K}{1 - t_K} = -\left(1 - \alpha\right)\left(\hat{K} - \hat{L}\right) \Leftrightarrow \hat{K} - \hat{L} = -\frac{1}{1 - \alpha}\frac{dt_K}{1 - t_K}.$$

We can plug this result into equations (6) and (4) to find

$$\hat{w}_S^{\text{Long}} = -\frac{\alpha}{1 - \alpha}\frac{dt_K}{1 - t_K},$$

which is what we were asked to show.

Part 3: Social Insurance: Adverse Selection

Consider an economy where individuals face a risk of becoming unemployed. If they become unemployed they incur a loss of income $d = 1$ assumed to be the same for all individuals. The risk of becoming unemployed θ is exogenous and heterogeneous across individuals. Assume that θ is uniformly distributed between $[0, 1]$ in the population. The individuals' willingness to pay for an insurance that fully compensates them for the income loss in the case of unemployment is given by:

$$w(\theta) = (1 + \alpha)\,\theta, \tag{11}$$

where $\alpha > 0$.

(3A) *Describe intuitively why α may be interpreted as a measure of risk aversion.*

A potential income loss of $d = 1$ that incur with probability θ implies an expected income loss of $\theta \cdot d = \theta$. A risk neutral person will value insurance at the expected benefits equal to the expected loss they would have without insurance ($w(\theta) = \theta$). A risk averse person will value the insurance higher than the expected benefits, which is consistent with $w(\theta) = (1 + \alpha)\,\theta$, where $\alpha > 0$.

(3B) *What share of the population would be covered by insurance in the first best alloca-*

tion, i.e. with perfect information?

In a situation with risk averse individuals, the first best allocation of insurance is full coverage (100 percent of the population), because - for very individual with $\theta > 0$ - the willingness to pay for the insurance is larger than the expected costs $w(\theta) = (1 + \alpha)\,\theta > \theta$.

Assume now that the risk parameter of an individual θ is private information. Consider a private insurance market with a public subsidy to unemployment insurance, where the subsidy implies that individuals only pay a fraction $(1 - s)$ of the market price (π). Hence only individuals with a willingness to pay above $\pi\,(1 - s)$ buy insurance. Assuming that the market is characterized by perfect competition, the market equilibrium price (π^*) is given by:

$$\pi^* = E\left[\theta \cdot d \,|w(\theta) > \pi^*\,(1 - s)\right] = E\left[\theta \,\middle|\, \theta > \frac{\pi^*\,(1 - s)}{1 + \alpha}\right] \tag{12}$$

(3C) *Provide an interpretation of equation (12), and explain why a market with perfect competition and free entry of insurance companies leads to the market equilibrium price given by this equation.*

Equation (12) states that the equilibrium price is equal to the expected income loss $(\theta \cdot d)$ for the share of the population that buys insurance. I.e. the share of the population with a willingness to pay above the market price net of the subsidy. To see why this price must be the equilibrium price consider a case, where the price is above π^*. In this case, the insurance companies charge a price above the expected costs and hence (on average) earn profits. The positive profits lure new companies into the market, which pushed the price down. Vice versa, if the price is below π^*, the insurance companies will on average make a loss, which is going to force some of the companies out of the market and increase the price.

(3D) *Show that the market equilibrium price equals $\pi^* = \frac{1+\alpha}{1+2\alpha+s}$. [Hint: recall that if a variable x is uniformly distributed on the interval $[0, 1]$, then the average of x over an interval from y to 1 is $E(x\,|x > y\,) = \frac{y+1}{2}$].*

We first find the marginal individual, who are indifferent between buying the insurance or not. This individual has $\theta = \bar{\theta}$ such that $w(\bar{\theta}) = \pi^*\,(1 - s) \Leftrightarrow \bar{\theta} = \pi^*\,(1 - s)\,/\,(1 + \alpha)$, which implies that everyone with a $\theta \geq \bar{\theta}$ will buy insurance. Using the hint we can compute the expected cost of insuring this part of the population as

$$E\left[\theta \mid \theta > \bar{\theta}\right] = \frac{\bar{\theta} + 1}{2} = \frac{\frac{\pi^*(1-s)}{1+\alpha} + 1}{2}$$

that in equilibrium must equal π^*. Hence, solving for π^* we obtain

$$\pi^* = \frac{\frac{\pi^*(1-s)}{1+\alpha} + 1}{2} \Leftrightarrow \pi^* = \frac{1+\alpha}{1+2\alpha+s},$$

which is what we were asked to show.

(3E) *How does an increase in the subsidy affect the market price and the share of insured people? Is it possible for a social planner to achieve the first best allocation in (3B) by setting an appropriate subsidy level?*

From the result in (3D) we see that a higher subsidy reduces the market equilibrium price (s appears in the denominator). This is driven by the fact that the extra individuals, who buy insurance only after a increase in the subsidy, are relatively low risk individuals. I.e. they have a θ below the old $\bar{\theta}$ and hence also below the old expected costs $E\left[\theta \mid \theta > \bar{\theta}\right]$ and adding these individuals to the pool of insured individuals reduces the average risk/cost and hence the equilibrium price.

A social planner can achieve the first best allocation in (3B) by setting the subsidy to 100% ($s = 1$). In this case the price that the individuals pay is 0 and everybody is buying insurance just as we argued they should in a first best situation in (3B). With a subsidy of 100% the market price becomes $\pi^* = \frac{1+\alpha}{1+2\alpha+1} = \frac{1}{2}$,which is the expeted cost for the entire population.