

Economics 230c
Public Sector Microeconomics
Due: Tuesday, 24 February

Spring 2009
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Problem Set #1

1. Fast forwarding the corporate tax rate.

Corporations in the United States must pay a 35% tax to the federal government. The corporate profit tax rate used to be higher; for example, from 1979-1986 the tax rate was 46%. Despite the (by historical standards) low tax rate of 35%, U.S. corporations pay more than \$300 billion in taxes to the federal government each year.

President Obama is widely rumored to be considering insisting that a corporate tax increase accompany any new legislation passed by the U.S. House of Representatives. One possibility is that the federal tax rate on corporate profits would be increased to 40%. An important question raised by this option is its effect on the behavior of corporations.

a) Consider the case of a corporation that rents movie DVDs to consumers at the market price, which is \$3 per DVD rented. The corporation has no fixed costs, and (somehow) has no capital costs, but incurs marginal costs for each video rented, given by the following schedule:

$$MC = q/100$$

in which MC is the marginal cost of renting an additional DVD, and q is the quantity of DVDs rented. The corporation's marginal costs consist of wages that it must pay to store employees; the reason that marginal cost increases with q is that additional customers generate crowding in the movie rental store, making it difficult for employees to render prompt and courteous service to all the customers, so employees must be paid more to compensate them for the additional strain they encounter on the job. (A similar process operates for employees of the University of California, all except for the part about wages rising.)

Assume that firms are able to choose q by choosing the number of DVDs they keep in stock. With a tax rate of 35% assessed on the profits of corporations, what quantity of DVDs will the firm choose to rent? What profits will the corporation earn after taxes are paid? Can you estimate the deadweight loss created by the tax on this firm's profits?

b) What effect would raising the corporate tax rate to 40% have on the quantity of DVDs the firm chooses to rent? What effect would the tax increase have on the firm's after-tax profits?

How much additional deadweight loss would be created? Why does the tax increase have these properties?

c) DVD rental companies are not the only corporations that would be affected by the proposed change in the corporate tax rate. Consider the manufacturing corporations that produce and sell mobile phones. Many of the costs incurred by these corporations represent costs of raising capital to invest in machines used in the manufacture of mobile phones. The production process exhibits constant returns to scale.

Corporations pay for their operations by issuing stock to investors, who then must be paid back by remitting dividends out of after-tax profits. Investors in mobile phone companies require an after-corporate-tax return of (at least) 7.8% on their money. Since the market in mobile phones is competitive, all firms in the market will provide exactly this return. All the firms that manufacture mobile phones are corporations.

Marketing studies find that customer demand for mobile phones is sensitive to price: at higher prices, individuals buy fewer mobile phones, and conversely, when the market is flooded with mobile phones, stores must lower prices in order to sell their inventories. This relationship between market prices and quantities sold also influences the profitabilities of firms in the market: firms earn lower returns on their investments when there are more mobile phones on the market. The relationship between the before-tax rate of return (r) for mobile phone manufacturing corporations and the quantity (Q) of mobile phones on the market is:

$$r = 0.20 - Q/500,000$$

When the corporate tax rate is 35%, what quantity of mobile phones will be manufactured by firms in this market? What effect would changing the tax rate to 40% have on the quantity of mobile phones manufactured? Does the current tax of 35% create a deadweight loss in this market? Why (or why not) do your answers look different from those in parts (a) and (b)?

2. The sickness unto debt.

A technology-savvy entrepreneur who is untutored in tax and financial matters requires advice on how to finance his new C corporation (a corporation whose income is subject to the corporate tax) that he formed to undertake an exciting high-tech investment project. The entrepreneur has committed to the company his great idea, in return for which he has given himself 100,000 shares of stock, but the company also requires an up-front investment of M , a very large amount of Money, and incurs costs of W for wages and materials during its first year. At the end of this first year, the investment will be worth one of two values: either L (low) or H (high), and at that point the investment project will be sold for cash to a foreign investor.

Assume that the values of L and H are common knowledge, as is the return distribution that with probability p the return is L , and with probability $(1-p)$ the return is H . The returns are such that $M > L > 0$, and $H > M$.

The investment amount M can be financed with debt, equity, or a combination thereof. The firm's annual interest rate on borrowing is r , and equity investors demand an annual return of at least e . The firm's taxable profits are subject to corporate taxation at rate t , where taxable profits in the good state of the world equal: $(H - W - M - \text{borrowing costs})$, and taxable profits in the bad state of the world equal: $(L - W - M - \text{borrowing costs})$.

- a) Suppose that $e = r$. Then are there any circumstances in which the firm would prefer equity finance to debt finance? Please offer an interpretation of your answer.
- b) Please solve for conditions that characterize the firm's optimal debt level as an implicit function of H, L, W, M, e, r, p , and t . What happens to the optimal debt level as t rises? What happens to the optimal debt level as p rises? Is the optimal debt level affected by values of H and L , and if so, how is it affected?

3. Investment credits for homework credit.

Consider a firm's investment problem in a discrete-time setting. Assume that the firm invests in a single type of capital that depreciates exponentially at a rate δ per year. The investment is financed by equity; the firm has no debt. Investments take place at the start of the year, and returns are received starting at the end of the year. The purchase price of capital goods is normalized to be unity. The firm pays a tax at rate τ on all investment returns, and is not permitted to deduct depreciation allowances in calculating taxable income. The government does, however, grant firms an investment credit of c for each dollar of capital expenditure. The firm discounts cash flows at rate r . Consequently, the firm in year 0 chooses capital investment (I_0) to maximize:

$$V = (1 - \tau) \sum_{t=0}^{\infty} Q(K_t) (1 + r)^{-(1+t)} + cI_0 - I_0,$$

in which the capital stock in year t , K_t , is a perpetual inventory of past investments:

$$K_t = \sum_{j=0}^t I_j (1 - \delta)^{t-j}.$$

In selecting I_0 , it is appropriate for the firm to take as given the values of $I_i, i = 1 \dots \infty$.

- a) Please derive the first-order condition describing the firm's optimal choice of I_0 . Assuming that the firm is in a steady state, so that $K_t = \alpha, \forall t$, please simplify to obtain an expression for the user cost of capital, $Q'(K_t)$.
- b) Suppose that the government sets $\tau = 0.6$ and $c = 0.2$. Please find the user cost of capital (as a function of r and δ).
- c) There is something called the “effective tax rate” on investment, which may be denoted τ^e , and is defined as:

$$\tau^e \equiv \frac{Q'(K) - \delta - r}{Q'(K) - \delta}.$$

Please offer an interpretation of the effective tax rate. In order to assist in this interpretation, it is helpful to solve the expression above for r . What is the effective tax rate on investment when $\tau = 0.6$ and $c = 0.2$?

- d) How does the effective tax rate vary with δ ? Is the relationship between δ and the effective tax rate monotone, and if so, then please offer an explanation for the sign of the relationship.
- e) Suppose that the government were to change the corporate tax rate, so that now $\tau = 0.2$ and $c = 0.2$. What is the effective tax rate on a new investment? What interpretation can one give to tax rules with $\tau = 0.2$ and $c = 0.2$?

4. Share and share alike.

Suppose one stock has two share classes. The share classes are identical in every way except that class A, which is traded in the United States, can be bought by anyone, while class B shares can only be bought by residents of Taxmania.

The prices of the stocks are P^* in Taxmania and P in the United States respectively. The stock pays dividends continuously at a dollar amount D per year. The tax rates on dividend income and capital gains are t_f in Taxmania and t in the United States; where $t_f > t$. (We assume that in each country the tax rate on capital gains equals the tax rate on dividends.)

A U.S. resident can indirectly invest into a Taxmanian stock by entering into a total return swap agreement with a Taxmanian resident, where the U.S. resident would receive all the

economic interest in a stock owned by the Taxmanian investor. Income received on a swap transaction is taxed as ordinary income at a rate $t^* > t_f > t$. You can initially assume that there is no cost for entering into the swap transaction, and that investors are risk neutral. Assume there is a fixed exchange rate of 1 to 1 between the Taxmanian and U.S. currencies. For convenience, we can normalize the price of the Taxmanian shares at $P^* = 1$.

- a) What would you expect the equilibrium price of P to be? Is there a range of prices that can be supported as equilibria?
- b) How would your answer change if investors are risk averse?
- c) How would your answer change if a U.S. investor entering into a swap transaction pays a fee p_f as a fraction of the stock prices P^* ?