1. Consider a world economy consisting of N identical countries, each endowed with one unit of land. The world contains one unit of capital, which is freely mobile between countries. Land, in contrast, is immobile. All countries have identical production technologies given by

\[ Y = K^a L^{1-a} \]

where K and L denote capital and land, respectively. The output price, \( p_Y \), is normalized to unity.

(a) Find the equilibrium interest rate and total income received by capitalists and landowners when none of the jurisdictions tax either capital or land. For \( a = .25 \), evaluate these quantities for \( N = 2 \) and \( N = 100 \). (Note that \( N = 100 \) means there is more land in the world than \( N=2 \)!) 

(b) Now consider the impact of a tax at rate \( \theta \) on capital income in country 1. Assume that revenues are used to purchase good Y, and that the government's purchases do not affect the production technology in country 1. The after-tax rate of return to capital invested in country 1 is now \((1-\theta)F_K\). Find new expressions for the after-tax interest rate, total landowner and capitalist income, and government revenue in country 1 as functions of \( N, \theta, \) and \( a \).

(c) For \( a = .25 \) and \( \theta = .25 \), find the change in total capital and total land income, and the revenue raised in country 1, if \( N = 2 \) and \( N = 100 \). What happens to the pretax marginal product of capital in the countries without taxes in these two cases? How do landowners in country 1 fare as a result of the tax? What do these examples suggest about the usefulness of the "small open economy" assumption that world interest rates are fixed, so capital taxes are shifted to land?

2. Consider an economy in which firms produce output using two capital inputs, equipment (E) and structures (S), according to the production technology

\[ Y = E^{.25} S^{.25} \]

Assume that the price of output is fixed at unity and that both equipment and structures are in infinitely elastic supply with a price of unity. Investors demand a required return of 10 percent on all capital investments, and both equipment and structures depreciate at a rate of 15 percent per year. Firms are 100 percent equity financed. In the initial setting, the tax rate on corporate profits is 50 percent and equipment investment can be expensed, while investments in structures are eligible for depreciation allowances equal to true economic depreciation.

(a) Describe the asset market equilibrium conditions that will govern investments in equipment and structures. For the parameter values specified above, find the numerical values that the pretax marginal products of equipment and structures must satisfy.

(b) Use the asset market conditions from (a) to obtain expressions for the firm's input demands E and S. If both equipment and structures could be expensed, what would the firm's output be? Compare this with the output that results when only equipment can be expensed. (You need not obtain numerical values here, but you do need to obtain an explicit expression for relative output). Describe how these results could be used to evaluate the deadweight loss of applying different tax rules to the two assets.
(c) If both equipment and structures could be expensed, the corporation tax would not raise revenue. When only equipment is expensed, however, the tax does raise revenue. Obtain an expression for the revenue yield of the corporate income tax when equipment is expensed but structures are depreciated according to true economic depreciation. Describe how you would find the corporate income tax rate that would be needed to raise the same revenue as the current tax system if both equipment and structures were eligible for true economic depreciation, i.e., if equipment could no longer be expensed. Would replacing the current tax regime with an equal-revenue regime in which both equipment and structures received true economic depreciation raise or lower output?