

## ECON 4622 – A2015

### Guidelines for marking.

#### Problem 1

a)

$\Omega$  is the sum of benefits accruing to the domestic population.  $f(k) - f'(k)k$  is the rent accruing to the country (to immobile factors).  $\rho c$  is the net-of-tax return to the residents of the country. Or we can note that  $-f'(k)k + \rho c = -(k-c)f'(k) - tc$ .  $(k-c)f'(k)$  is the return to capital going abroad (the total return minus the part accruing to domestic citizens). Put differently,  $(c-k)f'(k)$  is the net return from being capital exporter.  $tc$  is the tax payment of domestic residents.  $G(tk)$  expresses the benefit of public expenditures (=total tax revenue).

b)

Differentiating, we get

$$\begin{aligned} f'(k)k' - f'(k)k' - f''(k)kk' + f''(k)ck' - c + G' \cdot (k + tk') \\ = -f''(k)kk' + f''(k)ck' - c + G' \cdot (k + tk') = 0 \end{aligned}$$

$f''(k)kk'$  is the loss of rents due to outflow of capital.  $f''(k)ck'$  is the gain in terms of a larger return to domestically owned capital.  $c$  is the additional burden on domestic residents due to the tax increase. Or one can write  $(f''(k)k' - 1)c = cd\rho / dt$  which is the loss due to a decline in the net-of-tax return to domestic residents.  $G' \cdot (k + tk')$  is the additional benefit from public expenditures allowing for the mechanical increase in tax revenue and the loss due to capital outflow which shrinks the tax base. At the optimum the marginal benefits and costs just cancel out.

c)

The net-of-tax return must be the same otherwise there will be a gain from relocating a marginal unit of capital (no arbitrage condition).

d)

How is the allocation of capital across countries affected by a partial increase in  $t_1$ ?

$$\begin{aligned} f'(k_1) - t_1 &= f'(\bar{k} - k_1) - t_2 = \rho \\ f''(k_1)k_1' - 1 &= -f''(\bar{k} - k_1)k_1' \\ k_1' &= \frac{1}{f''(k_1) + f''(\bar{k} - k_1)} < 0 \end{aligned}$$

e)

From the first order condition  $-f''(k)kk' + f''(k)ck' - c + G' \cdot (k + tk') = 0$

$$G' \cdot k - c = f''(k)(k - c)k' - G' \cdot tk' = -G' \cdot tk' > 0$$

when the countries are identical and  $c=k$ . An increase in the tax rate in both countries will raise more revenue without affecting the allocation of capital, and the countries are better off since the marginal benefit from the publicly provided good exceeds the marginal cost. Initially there is under-provision due to tax competition driving down the tax base. The result is an allocation which is not Pareto efficient, and a Pareto improvement is possible by joint action.

## Problem 2

The problem relies on the article by Devereux and Griffith (2003) on the reading list, covered in the lecture notes of 14 September 2015,

<http://www.uio.no/studier/emner/sv/oekonomi/ECON4622/h15/teaching-material/lct14sep.pdf>

and also the topic of the seminar exercise of 6 October 2015,

[http://www.uio.no/studier/emner/sv/oekonomi/ECON4622/h15/seminaroppgaver/econ4622\\_assign\\_6oct15.pdf](http://www.uio.no/studier/emner/sv/oekonomi/ECON4622/h15/seminaroppgaver/econ4622_assign_6oct15.pdf)

- a) The variable  $r$  is defined as that after-tax real rate of return which is required by shareholders. One could add: There is no uncertainty in this model, and  $r$  is determined by the nominal market interest rate which plays the role as alternative rate of return, the personal taxation of this alternative rate of return, and the rate of inflation. The variable  $p$  is defined as the before-tax real rate of return of a project, net of depreciation. The variable  $\tilde{p}$  is defined as that value of  $p$  which is just sufficient so that a project earns the required real rate of return  $r$  after tax. In this case, when the before-tax real rate of return is  $\tilde{p}$ , the after-tax rent is exactly zero, and the project is called “marginal.” It is at the margin between being profitable and unprofitable. The EMTR is thus defined as the difference, for a marginal project, between the before- and after-tax real rates of return, scaled by the before-tax real rate of return. In short, this is a relative distortion in real rates of return due to the tax system. Since it is defined for the marginal project, it determines the cut-off point for investment under decreasing returns to scale. If  $f(I)$  is the net return of real investment before tax, then the cut-off is

$f'(I) = r$  if there is no tax distortion, but  $f'(I) = \tilde{p}$ , a different point, if the tax system is distortionary.

However, the distortion in net value of production will depend on the  $f$  function as well, not only on how much its derivative is distorted by the tax system.

- b) While the EMTR measures distortions to scale of investment under decreasing returns, there may also be a question of taxation leading to investment not being undertaken at all, or moved to some other country (or other tax sector). In particular, if the situation dictates that a project will only be undertaken once, it will be relevant to compare the after-tax rent from undertaking it in different countries with different tax systems. As a first approximation, this can be analyzed as if the project can be undertaken at the same scale either in one or in another country. The country which leaves the higher after-tax rent will be chosen by the owners of the firm. This will be the country with the lower average tax rate. In this case, EATRs can be compared. For the same project, a lower EATR implies a higher after-tax rent. A country with a lower EATR can expect to attract more investment of the type that is undertaken in only one country, all else equal.

- c) The first part of the statement is true. While the EMTR only depends on details of the tax system plus depreciation, inflation and the interest rate, the EATR also depends on the profitability of a project. In order to calculate the EATR, one must pick some project with some profitability. This is further clarified in the answer to part (d).

The second part of the statement is true in the literal sense, that is, the dependence on some chosen profitability means that some arbitrariness is introduced. In the comparison between countries (see part (b)), one can only be sure that the comparison is strictly true for that particular profitability. This is one valid argument against using the EATR.

However, this is hardly a good argument for never using the EATR to discuss distortions of tax systems. One main point of the article of Devereux and Griffith is exactly that the EATR is an important measure in addition to the EMTR, and there is no other theoretical measure of average tax rates that avoids the arbitrariness. One could avoid some of the problem by illustrating alternative levels of profitability, or by choosing some typical project based on empirical studies.

- d) The question is best answered if one observes that  $w = \tilde{p}/p$ , the ratio of the after-tax rate

of return of a marginal project to the after-tax rate of return (see the answer to part (b)) of the project with the chosen profitability (see the answer to part (c)). This definition of the weight will perhaps be memorized by some. The way the problem is formulated (with its given weight) we cannot expect that any candidate derives the formula. However, when a candidate considers the case  $w = 1$ , and observes that in this case, EATR is equal to EMTR, it should be clear that this happens exactly when the project is marginal, so that  $\tilde{p} = p$ . This should help the memory of this part of the curriculum.

The case  $w = 1$  occurs for the marginal project. This is not the kind of project one would use to compare tax systems in two different countries. There is little gain from moving a marginal project from one country to another.

The limit  $w \rightarrow 0$  occurs when  $p \rightarrow \infty$ , as shown in Figure 1 in Devereux and Griffith. This is the limit when profitability becomes extremely high. The EATR approaches  $T$ , the statutory corporate tax rate adjusted for personal taxes. Depreciation deductions do not matter in the limit, because they become vanishingly small in relation to the operating revenue. This is also not a good type of project to use for comparison, because such levels of profitability are not realistic. We must assume that depreciation deductions have economic significance, not only at the margin, but for average after-tax profitability.

**Problems 3 and 4** are open questions which test the ability to come up with relevant items and give well-structured answers. The time constraint will presumably limit how elaborate answers we will get.

### **Problem 3**

Leaving externalities aside, ideally one would like to leave intermediate goods unchanged and tax consumer goods uniformly (with some caveats). When financial institutions are tax exempt and taxes on inputs are not rebated there is a distortion in favour of own production. When taxes on inputs are passed on to the next non-exempt stage in the production-sales chain VAT is added even on the non-rebated VAT being passed on. There is cascading and final sales are being over-taxed. Sales from financial institutions to consumers are being under-taxed to the extent that financial services are “ordinary” consumption goods. However, this is not so clear when there is a margin-based charge on financial transactions and VAT may distort savings, etc. (conceivably currency trade, insurance, but only savings have been discussed ).

### **Problem 4**

a)

By tax evasion we mean illegal ways to escape taxes. One may underreport true income or wealth (for instance held abroad) in the tax return, or fail to charge taxes, e.g. VAT, when selling goods and services. And there are other examples. Also tax havens have been discussed a bit.

b)

The issues are addressed briefly in the articles on the reading list and discussed somewhat in the lectures. Here are some points that can be made.

Raising revenue may be difficult due to tax evasion. Public sector may be inefficiently small (or end up in financial trouble – cf. Greece).

Easily evaded taxes may have to be substituted by taxes that are more distortionary in other respects. For instance, one cannot rely on a neutral profit tax due to profit shifting.

Real resources may be used up in concealing tax evasion. The tax savings are private gains but no social gain while using up resources in pursuit of tax savings is a social cost.

There will be distortions in favour of sectors or organizational forms where taxes are more easily evaded. The effective taxes on some sectors or activities (where taxes are not easily evaded) are larger than taxes on other sectors and activities (where taxes are more easily evaded). More highly taxed sectors become inefficiently small.

Less productive evading agents may crowd out more productive non-evading agents.

Tax evasion may be linked to other crime.

Tax evasion may lead to excessive external costs where Pigouvian taxes are evaded.