Chapter 4 Review Questions

1. Explain how an increase in government spending and an equal increase in lump sum taxes can generate an increase in equilibrium output. Under what conditions will a balanced budget increase in government spending reduce equilibrium output? Are these conditions realistic?

A balanced budget increase in government spending will increase equilibrium output as long as the marginal propensity to consume is less than one $(c < 1)$. In this case the leakage effect of tax increases is mitigated because some of the reduction in disposable income would have otherwise been saved.

A balanced budget increase in government spending requires $\Delta G = \Delta T$.

Given a consumption function of the form $C = a + c(Y - T)$ the fall in consumption is $c\Delta T$.

Therefore, the change in net expenditures $= \Delta G - \Delta C = \Delta G - c\Delta T = (1 - c)\Delta G$

Hence the change in income is $\Delta Y = k[(1 - c)\Delta G]$ where *k* is the multiplier.

If $c < 1$ then $\Delta Y / \Delta G > 0$
$c = 1$ then $\Delta Y / \Delta G = 0$
$c > 1$ then $\Delta Y / \Delta G < 0$

If the marginal propensity to consume is greater than one a balanced budget increase in government spending would reduce equilibrium output.

Is this plausible? This would need consumption to respond more than on a one to one basis to the change in disposable income. This is possible if higher taxes induce households to save more or repay borrowing. Both of these are plausible. If disposable income is expected to be lower in the future households may decide to save more (precautionary saving) and reduce their current liabilities to guard against future negative income shocks. The opposite has seen to be true- where cuts in taxes lead to increased consumer confidence and greater increases in consumer expenditure than disposable income.

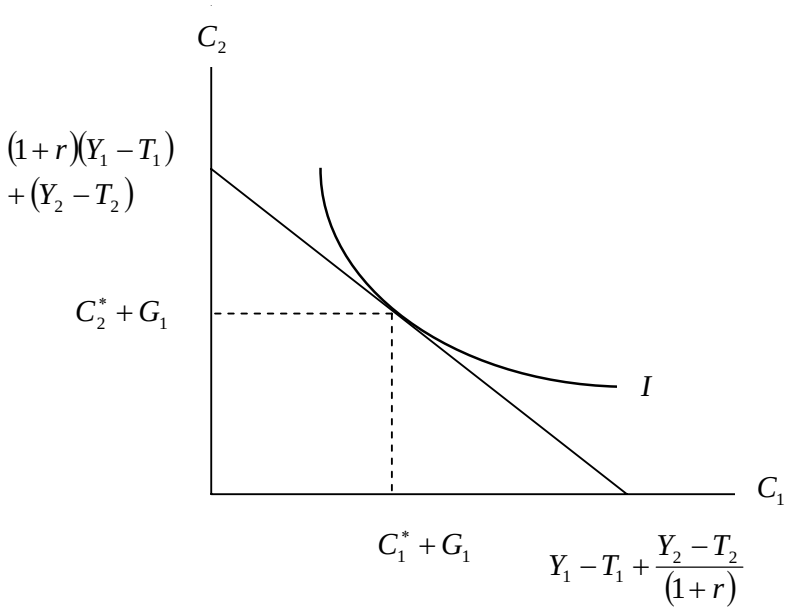
2. According to the theory of Ricardian Equivalence would there be any discernable differences between the effects of a £1 billion increase in government spending or a £1 billion cut in lump sum taxes?

One view is that there should be no discernable impact on output because both have the same impact on the household's intertemporal budget constraint. If government spending provides services (health, education etc.) to households, then a household's

consumption in a given period consists of a private (C) and a government (G) component. Therefore, the intertemporal constraint faced by the household is:

$$(C_1 + G_1) + \frac{(C_2 + G_2)}{1+r} \leq (Y_1 - T_1) + \frac{(Y_2 - T_2)}{1+r}$$

The household then chooses their path of consumer spending to maximise a utility function $U(C_1, C_2)$ subject to this constraint. The optimal consumption path (C_1^*, C_2^*) is found where the indifference curves formed by this utility function form a tangent to the intertemporal budget constraint.



The optimal level of consumption $(C^* + G)$ in each period will only change if there is a shift in the intertemporal budget constraint.

If the government must balance its long run budget, then what would be the impact of a rise in current government spending (ΔG_1)?

The first impact is a rise in the budget deficit. If funded by borrowing then government must run a surplus in the next period of $(1+r)\Delta G_1$. Hence, either:

$\Delta G_2 = -(1+r)\Delta G_1$ or,

$\Delta T_2 = (1+r)\Delta G_1$

In either case the household will reduce current private consumption so that $\Delta C_1^* = -\Delta G_1$ so that $(C^* + G)$ remains unchanged. In the first scenario, household

saving is increased so that future private consumption is increased in present value terms to offset the fall in government provided services. There is no change to the total level of consumption in either period, just the relative contributions of the private and government components.

In the second scenario, higher first period saving is used to pay higher future lump sum taxes leaving the components of second period consumption unchanged. The only impact here is a higher level of government provided consumption and a correspondingly lower level of private consumption in the first period.

Overall, as long as the government must balance its budget in the long run the increase in government spending has no impact on total spending in the economy as private household saving smoothes its impact.

The same outcome will occur if the government's policy were to cut current taxes.

If there is a reduction in current taxes then it is entirely saved. The proceeds are then used to fund either:

The increase in future taxes $\Delta T_1(1+r) = -\Delta T_2$ which has no impact on $\left(C^* + G\right)$ in either period.

Or

To replace the cut in future government spending with private consumption $\Delta C_2 = -\Delta G_2$.

In each of these cases there should be no impact on total expenditure in each period.

Therefore, according to the theory of Ricardian Equivalence both forms of fiscal expansion would have the same neutral effect on total spending in the economy. This result though depends on the assumption that household's view private and government provided consumption as substitutes for each other, i.e. both have the same effects on total household utility. The implication is that the government only provides services that households would otherwise purchase privately.

If this does not hold true, then changes in the composition of total consumption in each period may have an impact on its level. For example, suppose the government dramatically increases the provision of education, so that even if private consumption went to zero the level was greater than the representative household's optimal level. In this case government spending may have non-neutral effects on total lifetime utility and therefore the pattern of intertemporal consumption.

3. How might a reduction in the tax rate actually lead to an increase in tax revenues? What would be the expected income tax revenues at 0 per cent and 100 percent? What might the relationship between tax rates and tax revenues look like? Explain your answers?

A reduction in the tax rate may increase tax revenues by creating incentives to work. Even though the government collects fewer taxes on each hour worked, total tax revenues increase because more hours are worked.

The relationship between work and taxes can be derived from a model of rational choice. Households have preferences between income (a good thing) and work (which creates disutility) Therefore, indifference curves in *Y*-*L* space are upward sloping, as the worker can only be kept at the same level of utility following an increase in work if their income rises in compensation.

The relationship between income and labour supply is:

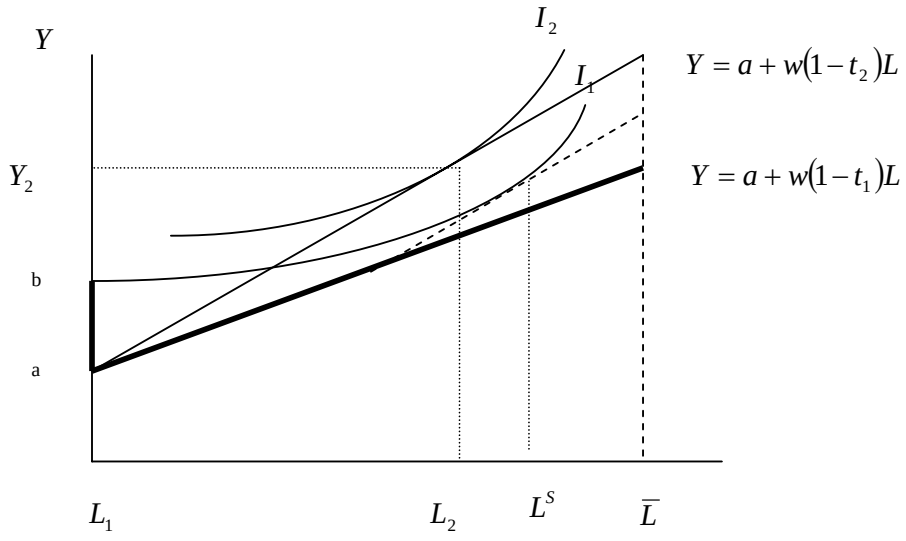
$Y = b$ if $L = 0$

$Y = a + w(1-t)L$ if $0 < L \leq \bar{L}$

Where $\bar{L}$ is the maximum possible amount of labour in a given time period, *w* the wage rate and *t* the marginal tax rate. It is assumed that $b > a$ reflecting the cost of work in terms of forgone benefits.

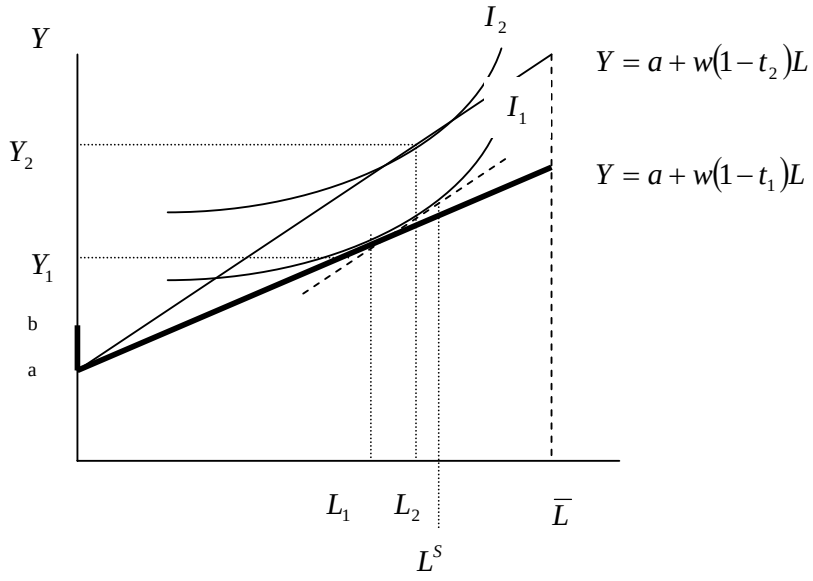
Total labour increases because either those who are not working are attracted into the labour force, or those that are already working increase their work input.

i) Encourage participation



The household's initial labour input is $L_1 = 0$. A reduction in income taxes leads to a pivot in the constraint so that each unit of labour input produces higher disposable income. The new utility maximisation labour input is now $L_2 > 0$. In this case there is a large substitution effect L^S towards labour and away from leisure. The income effect $\left(L^S - L_2\right)$ is relatively small. This is a negative effect because the lower tax rate enables households to consume more leisure and maintain income at a certain level.

ii) Existing workers work harder



Workers initially choose to supply a labour input of L_1, the fall in the tax rate leads to a new optimum input of L_2. In this scenario, the substitution effect is smaller because workers are already supplying labour.

This model suggests that income tax reductions will have the largest impact on labour supply by increasing participation rather than encouraging existing workers to work harder.

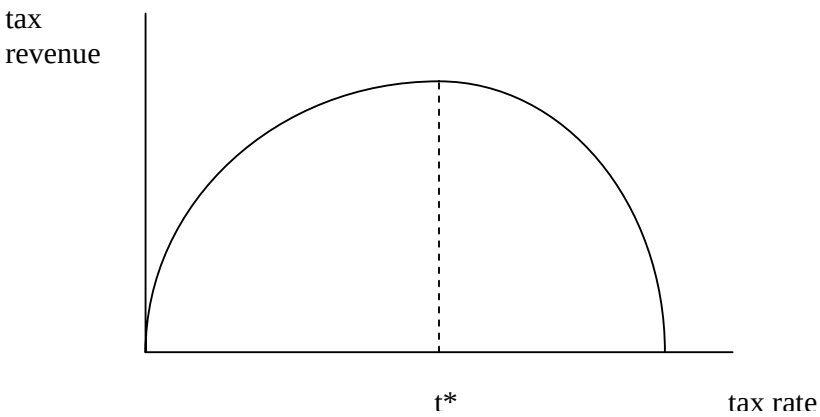
At a tax rate of 0%, tax revenues will obviously be zero as no matter how much income is earned, none of it is transferred to the government. At a tax rate of 100% it is also assumed that tax revenues will be zero. From the above, if $t = 1$

$Y = b$ if $L = 0$

$Y = a$ if $0 < L \leq \bar{L}$

If $b > a$ it would never be optimal for a household to supply positive labour. It could also be the case that $L = 0$ and that $b < a$. This implies that there is a financial penalty to not working, but this penalty is not great enough to offset the disutility from working. The main conclusion is that at a tax rate of 100% the marginal utility from the income earned will always be zero, whereas the marginal disutility of actually doing the work is positive. Hence, optimal labour supply will in all likelihood be zero.

The relationship between tax rates and tax revenue is commonly-thought to be hump shaped as is known as the Laffer curve.



At low tax rates the disincentive effects of work are small so labour supply is high. But because each worker pays very low taxes, overall tax revenues are small. Increases in the tax rate then lead to higher tax revenues, because the direct effects of the tax increase are stronger than the indirect disincentive effects of higher taxes on labour supply. However as the tax rate increases the impact of the disincentive effects grows. At the rate t^*, further increases in the tax rate generates a fall in revenue as the indirect effects on labour supply start to dominate.

More advanced problems

4. Suppose the economy is characterised by the following set of equations

$C = 200 + 0.7\ Y_d$

$Y_d = Y - T$

$I = 100$

$G = 200$

$T = 200$

Where C is consumption, Y_d is disposable income, T is lump sum taxes, Y is GDP, I is investment and G is government spending.

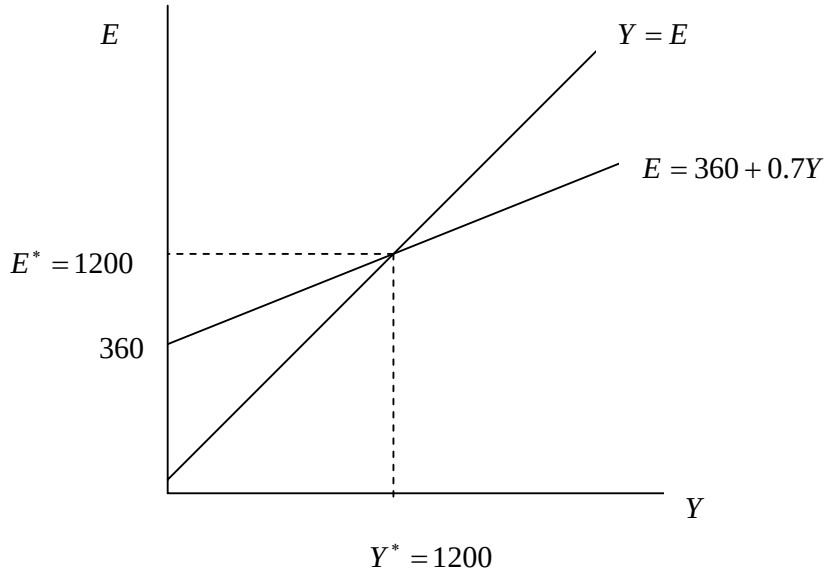
a. Calculate the equilibrium level of income in this economy.

Equilibrium requires output equalling planned expenditures Y = E. Given that $E = C + I + G$:

$$Y = 200 + 0.7 * (Y - 200) + 100 + 200$$

$$Y(1 - 0.7) = 360$$

$$Y = 360/0.3 = 1200$$



At equilibrium output $Y^* = 1200$, $C = 200 + 0.7 * (1200 - 200) = 900$, $I = 100$ and $G = 200$.

b. What is the value of the multiplier?

The multiplier $k = 1/(1 - mpc)$

$k = 1/(1 - 0.7) = 3\frac{1}{3}$

c. The government decides that income is too low and wishes to expand the economy by cutting lump sum taxes to 100. Calculate the new equilibrium level of income.

Substituting into the workings from part a. cutting lump sum taxes to 100

$Y(1-0.7)=430$

$Y_2^* = 430/0.3 = 1433\frac{1}{3}$

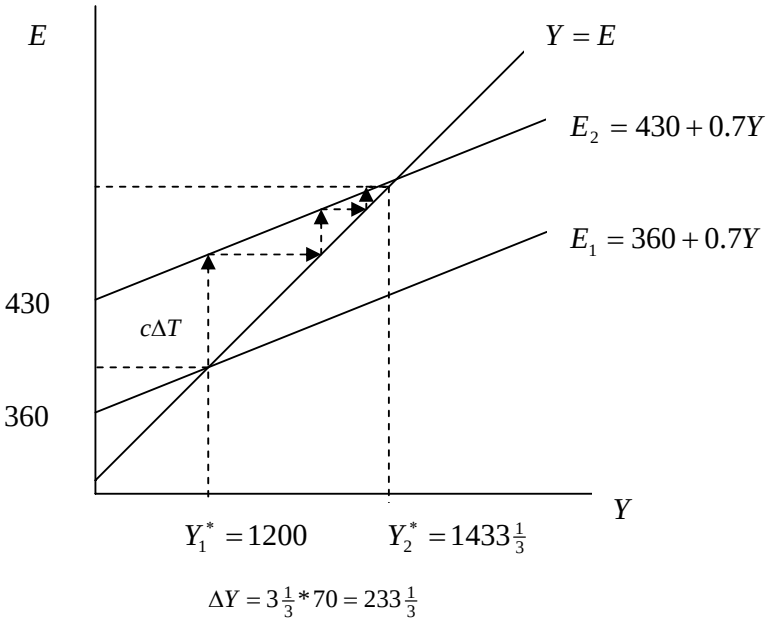
Or the change in income is equal to the product of the multiplier and the change in autonomous expenditures.

$\Delta Y = k * \Delta AE$

$\Delta AE = 0.7 * (100) = 70$

$\Delta Y = 3\frac{1}{3} * 70 = 233\frac{1}{3}$

$Y_2^* = 1200 + 233\frac{1}{3} = 1433\frac{1}{3}$



d. The government is now concerned about the rising level of government debt so cuts government spending by 100 units. What happens to the equilibrium level of income? Comment on your findings.

Substituting a cut government spending by 100 into the workings

$Y(1-0.7)=330$

$Y_3^* = 330/0.3 = 1100$

Or

$\Delta Y = 3\frac{1}{3} * (-100) = -333\frac{1}{3}$

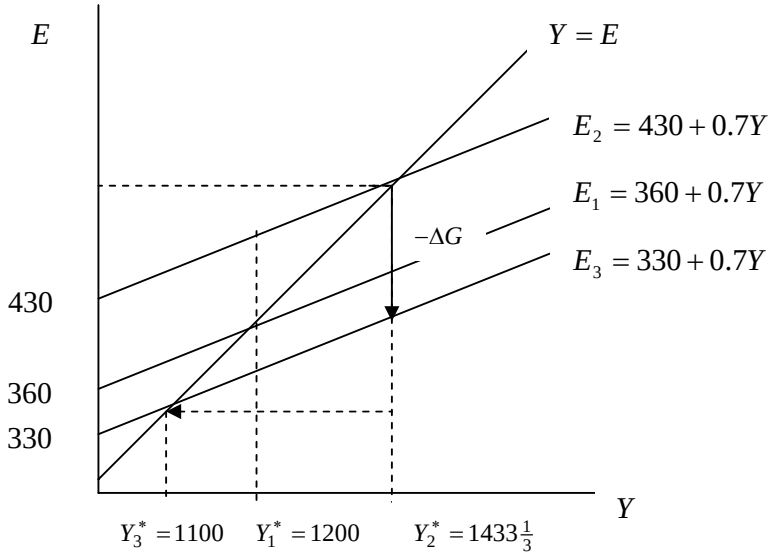
Hence $Y_3^* = 1433\frac{1}{3} - 333\frac{1}{3} = 1100$.

This is an example of the balanced budget multiplier, where a cut in government spending funded by a rise in lump sum taxes reduces equilibrium income. This is because the marginal propensity to consume is less than unity, hence leakages > injections.

The total change in autonomous expenditures is $\Delta C - \Delta G$:

$\Delta Y = 3\frac{1}{3} * (70 - 100) = -100$

Hence, $Y_3^* - Y_1^* = -100$.



5. Instead of using lump sum taxes the government raises revenue with a proportional income tax.

$T = tY$ *where t is the marginal tax rate*

a. Derive the new consumption function. Using the Keynesian cross show how changes in the marginal tax rate affect equilibrium income.

If $T = tY$ then disposable income is $Y^d = (1 - t)Y$:

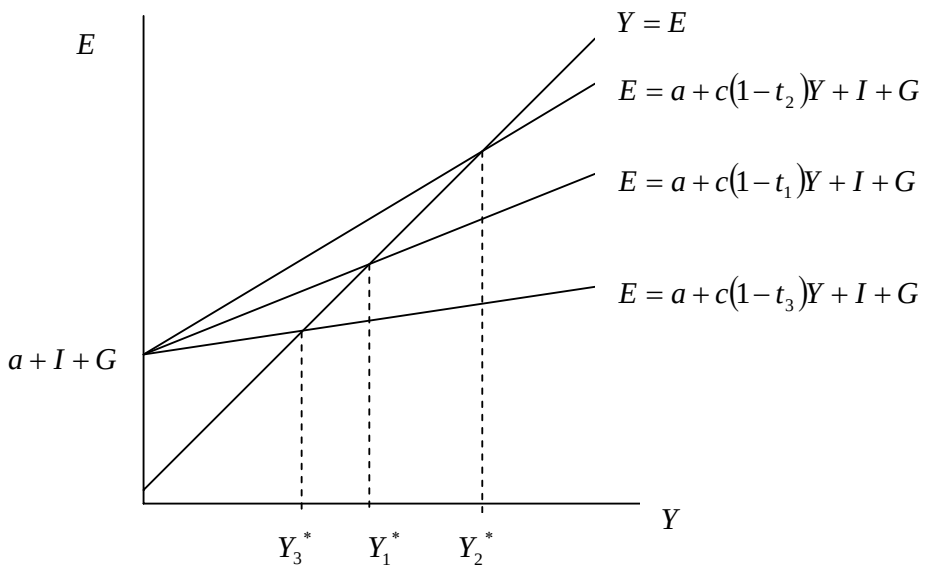
$C = a + c(1-t)Y$

The expenditure function is $E = a + c(1-t)Y + I + G$

Changes in the tax rate lead to pivots in the expenditure effect.

Equilibrium income is where:

$$Y^* = \frac{a + I + G}{1 - c(1-t)}$$



$$Y_1^* = \frac{a + I + G}{1 - c(1-t_1)},\ Y_2^* = \frac{a + I + G}{1 - c(1-t_2)},\ Y_3^* = \frac{a + I + G}{1 - c(1-t_3)}$$

Changes in the tax rate influence equilibrium output by altering the multiplier effect $k = 1/(1 - c(1-t))$ of the initial level of autonomous expenditures $a + I + G$.

b. By examining the multiplier, explain why proportional taxes are an automatic stabiliser on output compared to lump sum tax rates.

With proportional taxes the multiplier is:

$$k = \frac{1}{1 - c(1-t)}$$

Hence, $\frac{\Delta k}{\Delta t} < 0$, the size of the multiplier falls as the tax rate increases.

Any shock to autonomous expenditures will therefore have a smaller impact on output.

$\Delta Y = k\Delta AE$

The dampening effect on equilibrium output is because tax revenues are procyclical, unlike a lump sum tax where they are constant. When autonomous expenditures rise, tax payments increase so output rises by a smaller amount. However, when autonomous expenditures fall, tax payments also fall leading to a smaller decline in output.

c. The government wishes to undertake a program of public works costing £5 billion but must balance its budget. If the current level of GDP is £100 billion, would the government be correct to raise the tax rate by 5%? Explain your answer.

The logic for increasing the tax rate by 5% is because 0.05*£100 billion = £5 billion. However, this ignores the fact that the increase in government spending will increase equilibrium income, and because taxes are proportional to income taxes revenues will rise at the current tax rate. The arithmetic would suggest that if spending increases by £5 billion and taxes are proportional, the necessary increase in tax rates will be less than 5%.

$\Delta Y = k * £5bn$

$\Delta T = t * \Delta Y$

As long as the multiplier is positive the increase in the required rise in the tax rate would be less than 5%.

It is a little tricky to work out exactly how much taxes must change because the tax rate will also affect the multiplier.

6. The structure of the economy is fully described by the following equations.

$Y = C + I + G$

$Y = 6000$

$G = 800$

$T = 800$

$C = 300 + 0.75 (Y-T)$

I = 1200 -6000r

a. *Calculate the equilibrium interest rate, the level of investment, and the government's budget deficit.*

Equilibrium is where output equals planned expenditures

$$Y = C + I + G$$

Substituting from the above:

$$6000 = 300 + 0.75 * (6000 - 800) + 1200 - 6000r + 800$$

$$6000 = 6200 - 6000r$$

Equilibrium interest rates are

$$r = 200/6000 = 0.03333 \text{ or } r = 3\tfrac{1}{3}\%$$

Investment in equilibrium is:

$$I = 1200 - 6000 * 0.03333 = 1000$$

The budget surplus is:

$$G - T = 800 - 800 = 0$$

b. Recalculate the items listed in part (a) when the level of government spending rises to 1000. Explain your findings.

The new equilibrium values are:

Interest rates:

$$6000 = 6400 - 6000r$$

$$r = 400/6000 = 0.06666 \text{ or } r = 6\tfrac{2}{3}\%$$

Investment:

$$I = 1200 - 6000 * 0.06666 = 800$$

Budget surplus

$T - G = 800 - 1000 = -200$

The increase in government spending leads to a budget deficit. If output remains at the same level this puts upward pressure on interest rates which crowds out an equal amount of investment expenditure.

The basic intuition is that if the government runs a deficit, then it needs to fund this by borrowing from the private sector. To encourage the private sector to lend funds the government may offer a higher interest rate on its borrowing. The implication is that if the government runs a deficit it demands loanable funds that might otherwise have been directed to firm investment. Hence there is a crowding out effect of budget deficits on investment.

c. Given that the level of GDP is held fixed at 6000, what reasons might account for a policy of raising taxes to 1200.

Following on from part b, the new equilibrium values are:

Interest rates:

$6000 = 6100 - 6000r$

$r = 100/6000 = 0.01666$ or $r = 1\frac{2}{3}\%$

Investment:

$I = 1200 - 6000 * 0.01666 = 1100$

Budget surplus

$T - G = 1200 - 1000 = 200$

The impact of the tax rise is to reduce consumption by 300, but this depresses interest rates which crowds in an additional 300 units of investment. The tax increase is therefore appropriate if the government wishes to re-balance the economy towards investment.

7. What are the implications for Ricardian equivalence if a proportion τ of the population dies at the end of each period? How would your answer change if it is established that people care about their offspring, and can leave bequests?

In a simple two period model lifetime utility might be described as the utility gained from consumption in each period. However, if the probability of being alive in the second is less than one it would be natural to discount this future utility.

$$U(C_1, C_2) = u(C_1) + (1-\tau)u(C_2)$$

The impact of a current period tax reduction on consumption can be assessed by considering the two extreme cases.

When the probability of death is zero $(\tau = 0)$ the household is alive in period two with certainty. Therefore, if as expected the government raises future taxes by an equal amount in present value terms to maintain a long term balanced budget then there is no impact on the lifetime budget resources and Ricardian Equivalence results.

However, if death was certain $(\tau = 1)$ it is unlikely that any household will worry about future tax liabilities and will consume all of the tax reduction. In this case Ricardian Equivalence fails perfectly and current income is determined by current disposable income.

The same principal would be expected to apply, but to a lesser extent, for any probability of death between zero and unity. Therefore, a departure from Ricardian Equivalence would be anticipated if the future is discounted or people have finite horizons. (See Olivier Blanchard (1985): *Debts, deficits and finite horizons,* Journal of Political Economy 223-247)

A counter argument in support of the Ricardian Equivalence proposition arises if people care about the utility of future generations and can leave bequests, even if people have finite lives (see Barro (1974): *Are government bonds net wealth?* Journal of Political Economy 1095-1117)

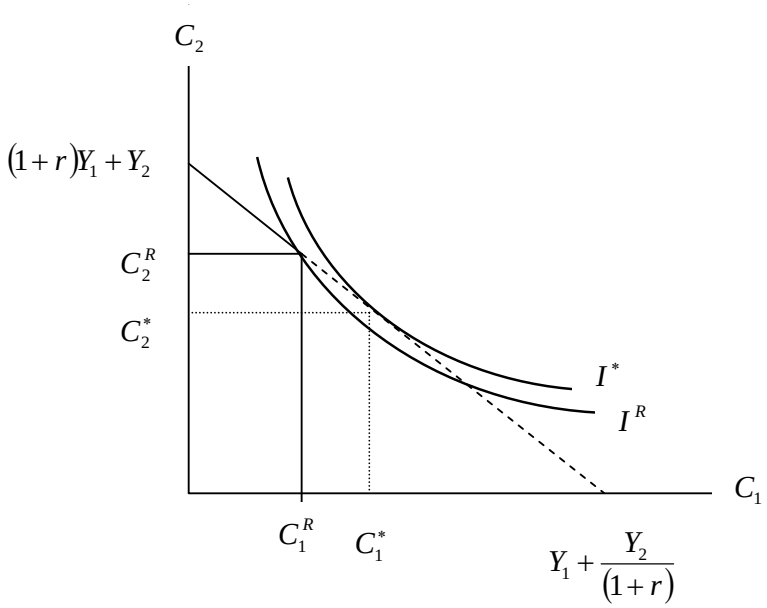
The intuition is that even if the household expects to die before an expected future tax increase is enforced, the household may care about the utility of their children. If they can leave bequests they may therefore reduce current consumption to increase the value of bequests. The bequest motive plays the same role as savings in smoothing consumption, the only difference is that consumption is smoothed across generations rather than across periods within the same lifetime.

The evidence on bequest motives though is not fully supportive. Although bequests are operational, the evidence tends to suggest that uncertainty over the timing of death means most bequests are accidental. There is also a literature which argues that bequests are used to manipulate children's behaviour (see Bernheim, Schleifer and Summers (1985): *The strategic bequest motive,* Journal of Political Economy 1045-1076), rather than due to altruistic motives.

8. Explain how borrowing constraints affect the validity of Ricardian equivalence for

a. A temporary tax cut

If a borrowing constraint is binding, then it suggests that current consumption is below its utility maximising level $\left(C_1^R < C_1^*\right)$ and there is insufficient consumption smoothing.



The issue is that households cannot borrow sufficiently against future resources. In this case, a current tax cut may increase consumption even if it does not alter lifetime resources nor shift the budget constraint. This is because it alleviates some of the credit constraint and makes consumption on the dashed segment of the budget constraint feasible, so current consumption can increase towards its optimal level.

b. An announced future tax cut

In the absence of borrowing constraints a household can increase current consumption by borrowing against the future tax cut. However, if there are binding borrowing constraints this option is unavailable and has no impact on current consumption.

9. "The national debt is an irrelevant proposition because it will never be repaid. The national debt is irrelevant because we owe it to ourselves." Discuss

The dynamics of the national debt are:

$$D_t = (1+r)D_{t-1} + B_t$$

The debt at time t is equal to its level last period, plus the interest costs of sustaining the debt and the current budget deficit $B_t = G_t - T_t$.

Therefore, even the debt is fairly considerable it can be held at a given level by simply paying the interest burden on the debt. Most of the debt can be continuously rolled over continuously. Repayment of the debt isn't necessary as long as the cost of servicing the debt isn't too great.

However, there are two factors that make the national debt relevant.

- Real resources used: the continual funding of the debt requires output that could otherwise have contributed in a direct way to the welfare of society.
- Interest rate effects: In order to market the debt the government may have to offer a higher interest rate on bonds. This will increase whole economy interest rates and depress investment.

An important consideration is how the interest rate compares to the growth rate of the economy. If $r_t < g_t$ then the debt to GDP growth will head towards zero, $D/GDP \to 0$ in this case there is debt stabilility. When the debt position becomes unsustainable the real resource costs of the debt will grow as a proportion of GDP.

The fact that national debt is irrelevant because we owe it to ourselves is a statement in support of Ricardian Equivalence. A budget deficit is indicative of low current taxes or high government spending. If the government is to balance its budget in the long run then the current debt is equal to the present discounted value of future liabilities. In effect this represents a household that borrows in the current period, and repays in the future. Therefore, there is no discernable impact on the total present discounted value of lifetime resources.

This is not necessarily true if there are departures from Ricardian Equivalence. For example, a tax cut enables a household to circumvent borrowing constraints that might otherwise be binding. In addition, issues such as future generations and bequest motives, a positive probability of death, and distortionary taxation might complicate the neutrality effect of fiscal policy.