ECONOMICS TRIPOS PART IIA

2020 2.00pm − 5.00pm

Paper 2

MACROECONOMICS

MOCK EXAM

This paper comprises three sections: A, B and C.

Answer **ALL FOUR** questions from Section A.
Answer **ONE** question from Section B.
Answer **ONE** question from Section C.

Section A will carry 50% of the marks, with each question weighed equally. Sections B and C will each carry 25% of the total marks for this paper.

Write you **name** on the top of your answer sheet.

Candidates are asked to note that there may be a reduction in marks for scripts with illegible handwriting.

If you identify an error in this paper, please alert the **Invigilator**, who will notify the **Examiner**. A **general** announcement will be made if the error is validated.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator.

SECTION A

A.1 The US Federal Government has had funding gaps on 20 occasions since 1974, the most recent caused a government shutdown during the evening of 9th February 2018. Suppose investors are concerned that the US government will temporarily default on its debt payments in 3 months due to a failure to agree on lifting the debt ceiling. Analyse the likely effect of this on the price and yield of US Treasury bills and bonds with a maturity of 1-month, 3-months and 3-years. Use your answer to explain how this may affect the shape of the US yield curve.

A.2 Consider the following stylised household budget constraint:

$$(1+\nu_1)c_1 + \frac{(1+\nu_2)}{1+r_2}c_2 = \bar{y},$$

where c_t denotes real consumption in period-t, ν_t denotes a period-t Value Added Tax (VAT), and $\bar{y}$ is the present discounted value of income (assumed constant). On 24th November 2008, in an effort to combat recession, the UK Chancellor Alistair Darling announced a temporary VAT cut of 2.5pp.

(a) Draw the budget constraint before and after the VAT cut in the present period.
(b) Analyse the likely impact on consumption in both periods. You may assume consumption is a normal good.

A more realistic model would also incorporate credit constraints in the household problem. Assume, due to frictions in credit markets, consumption may be at most $\tau\bar{y}$ in the current period, where $\tau \in (0,1)$.

(c) Illustrate how a change in the credit constraint, τ, may reduce the efficacy of attempts to stimulate current consumption through a VAT cut.

A.3 Consider a real business cycle setup with private consumption and government expenditure. Assume that there is no investment and the economy is closed.

(a) Illustrate the effect of a (lump-sum) tax-financed permanent expansion in government spending on output and on the real interest rate in the context of an intertemporal macroeconomic model. Explain intuitively and use graphs to illustrate your answer.
(b) Now suppose that, instead of lump-sum taxes, the government must use distortionary labour income taxes to finance its expansion in spending. How does this change alter you answer above? Explain intuitively and use graphs to illustrate.

A.4 On 22nd January 2015, the European Central Bank announced that it would expand its asset purchase programme to include euro area government bonds, along with covered bonds and asset-backed securities. The combined monthly asset purchases were announced to amount to €60bn. On that day, the euro depreciated against the US dollar by 1.5%.

(a) Could this be consistent with the asset market model of the exchange rate. Explain.

(b) On the same day, concern grew that an anti-austerity party would take power in the Greek elections, which were held on 25th January 2015. Explain how the asset market model can be augmented to account for the effects of political uncertainty and risk. To what extent does the increased political uncertainty on 22nd January 2015 reinforce or reverse the exchange rate effects discussed in part (a)?

(c) Using the DD-AA model, assess how an increase in political uncertainty and risk influences macroeconomic outcomes. Explain and evaluate your answer.

SECTION B

B.1 Consider a price-taking representative agent who faces the following optimisation problem:

$$\max_{c_1,c_2,b_2,\ell_1,\ell_2} \{\ln c_1 + \ln \ell_1 + \beta(\ln c_2 + \ln \ell_2)\},$$

subject to:

$$\begin{aligned} c_1 + b_2 &= w_1(1-\ell_1) - T_1, \\ c_2 &= w_2(1-\ell_2) + b_2(1+r_2) - T_2, \end{aligned}$$

where c_t denotes consumption, ℓ_t leisure, b_t savings, T_t lump-sum taxes, w_t the real wage, r_t the real interest rate, and β the intertemporal discount factor ($0 < \beta < 1$). The subscript $t = 1, 2$ denotes the time period.

(a) Derive the agent's intertemporal budget constraint. Give an economic interpretation of the result.
(b) Find the optimality conditions for c_1, c_2, b_2, ℓ_1 and ℓ_2. Derive the intertemporal Euler equation for consumption, and the intratemporal (i.e. within period) Euler equation characterising the optimal trade-off between consumption and leisure. Give an intuitive explanation of these Euler equations.

Assume that the economy is closed and that there is no investment. So the GDP identity is given by $y_t = c_t + g_t$, where g_t denotes government purchases, which are exogenous, and y_t denotes aggregate output, which is equal to $y_t = w_t(1 - \ell_t)$. Suppose that $w_t = A_t$, where A_t represents productivity in period $t = 1, 2$. In addition, assume that the government runs a balanced budget such that $T_t = g_t$.

(c) Solve for the equilibrium level of output y_t in terms of A_t, g_t and r_t for $t = 1, 2$.
(d) Given our assumption of a closed economy, the general equilibrium condition for bonds states that $b_2 = 0$. Using this information and your optimality condition for b_2 write the real interest rate $1 + r_2$ as a function of A_t and G_t for $t = 1, 2$. Combine this with your answer to part (c) to rewrite the equilibrium level of y_t in terms of A_t and g_t only, for $t = 1, 2$.
(e) Derive the fiscal multiplier dy_1/dg_1 for a permanent increase in g_1. Provide an intuitive explanation of the results.

B.2 Consider the Bernanke-Blinder extension to the ISLM model. Banks are assumed to hold bonds B, loans, L, and reserves, R, as assets, and have deposits, D, as liabilities, so that the representative bank's balance sheet is:

$$B + L + R = D.$$

Reserves are equal to the legal minimum reserve requirement $R = \tau D$, where $\tau = \frac{1}{3}$. This yields the supply of deposits in the money market:

$$D^s = 3R.$$

The demand for deposits is given by the traditional money demand equation

$$D^d = Y - \frac{1}{2} i_B,$$

where Y is real aggregate output and i_B is the bond interest rate. The supply of loans is described by:

$$L^s = \frac{3}{4}(D - R).$$

The demand for loans is described by:

$$L^d = Y - \frac{1}{4}(i_L - i_B).$$

where i_L is the loan interest rate. The goods market equilibrium is described by:

$$Y = 60 - \frac{1}{4} i_L - \frac{1}{4} i_B.$$

(a) Derive the equilibrium bond interest rate i_B in the money market in terms of output, Y and reserves, R, and the equilibrium loan interest rate i_L in the loan market in terms of output, Y, reserves R and the equilibrium bond interest rate, i_B. Give an intuitive explanation.

(b) Derive output, Y, in terms of reserves, R, and the equilibrium bond interest rate, i_B, such that there is equilibrium in both the goods market and the loan market. Give an intuitive explanation.

(c) Suppose the central bank increases the level of reserves from $R = 10$ to $R' = 12$. Compute the initial and new equilibrium level of output, Y, and the bond interest rate, i_B. Illustrate the effect graphically and provide an economic explanation.

(d) Suppose that the central bank subsequently raises the required reserve ratio to $\tau = \frac{1}{2}$ to address liquidity problems in the banking sector. Explain how this affects the equilibrium level of output, Y and the bond interest rate i_B. Provide a graphical illustration.

SECTION C

C.1 On 22nd December 1994, the Mexican peso depreciated by about 21% against the US dollar at the start of what became known in financial markets as the 'Tequila crisis'. Using examples, discuss what could be the causes of a currency crisis.

C.2 Since the start of 'quantitative easing' (QE) by the Bank of England in March 2009, banks' reserves at the Bank of England have risen by about £240bn and the monetary base has more than tripled, whereas M4 has remained almost unchanged. Analyse what the likely effect of QE would have been on reserves, the monetary base and M4 if banks had used it to fully expand their lending. Aside from the bank lending channel, discuss alternative theoretical channels through which QE could have been effective in the UK.

C.3 The United States regularly extends the duration of unemployment benefits during recessions. Discuss, in the context of models of the labour market, how such an extension may affect the behaviour of the unemployment rate, and possible consequences on the subsequent recovery.

C.4 A pervasive argument in the debate concerning the effectiveness of fiscal policy is of the type: "A dollar spent by the government is a dollar taxed, in the present or in the future. So, government spending cannot stimulate the economy, let alone private demand." Discuss to what extent this argument is faulty, and to what extent it is correct.

END OF PAPER

Solutions

Section A Solutions

A.1 The US Federal Government has had funding gaps on 20 occasions since 1974, the most recent caused a government shutdown during the evening of 9th February 2018. Suppose investors are concerned that the US government will temporarily default on its debt payments in 3 months due to a failure to agree on lifting the debt ceiling. Analyse the likely effect of this on the price and yield of US Treasury bills and bonds with a maturity of 1-month, 3-months and 3-years. Use your answer to explain how this may affect the shape of the US yield curve.

Suggested Answer

The asset market model for the demand and supply of bonds may be summarised by the following equation:

$$B^d\underset{-}{(p_t};\ \underset{+}{p^e_{t+1}},\ \underset{-}{RR^e_{t,o}},\ \underset{-}{\sigma_B/\sigma_O},\ \underset{+}{liq_B/liq_O},\ \underset{+}{W_t}) = B^s\underset{+}{(p_t};\ \underset{+}{\pi^e_t},\ \underset{+}{\Pi^e_t},\ \underset{+}{G_t - T_t}),$$

where:

- p_t represents the price of the bond.
- p^e_{t+1} represents the expected price of the bond next period.
- $RR^e_{t,o}$ represents the expected rate of return on the bond relative to other assets.
- σ_B/σ_O represents the relative riskiness of the bond, compared to other assets (volatility).
- liq_B/liq_O represents the liquidity of the bond, relative to other assets (convertibility into cash).
- W_t represents investors current wealth.
- π^e_t represents the expected real value of future coupon and redemption payments.
- Π^e_t) represents the expected profitability of investment opportunities (for investment bonds)
- and finally, $G_t - T_t$ represents the government budget deficit (for government bonds).

In the context of the question, B^s may be taken as *fixed* or *perfectly elastic* in the short-run. Answers may concentrate on the impact on the demand for US Treasury bills and bonds. As a failure to agree to lifting the US debt ceiling increases, the riskiness of the 3-month US Treasury bill increases, $\sigma_B \uparrow$. This should reduce demand for this asset.

However, given fixed supply of this Treasury bill, this must result in the current price falling, $p_t \downarrow$, to restore equilibrium in the market. The 3-month yield therefore increases.

Turing to the 1-month Treasury bill, the *relative* risk has fallen due to the increase in riskiness of the 3-month Treasury bill, with $\sigma_O \uparrow$. This may increase demand for the 1-month Treasury bill, and hence increase its price (and reduce yield) in equilibrium.

There are more possibilities for the impact on 3-year Treasury bonds, which will critically depend on market beliefs at this horizon. Assuming that the default risk is believed to subside within a 3-year horizon, a similar argument to that for the 1-month Treasury bill may be made for 3-year Treasury bonds (the price may increase and yield fall).

Overall, the yield curve may be expected to become more hump-shaped around the 3-month horizon, with an increase in the 3-month yield and reductions at the 1-month and 3-year horizons.

The best answers will link the changes in 1-month and 1-year bond prices to the models studies in class. For example, under the **expectations theory** price movements should be the same across all maturities. The **segmented markets** theory is relied upon to give differential price (and hence yield) responses.

[**12.5 marks**]

A.2 Consider the following stylised household budget constraint:

$$(1+\nu_1)c_1 + \frac{(1+\nu_2)}{1+r_2}c_2 = \bar{y},$$

where c_t denotes real consumption in period-t, ν_t denotes a period-t Value Added Tax (VAT), and $\bar{y}$ is the present discounted value of income (assumed constant). On 24th November 2008, in an effort to combat recession, the UK Chancellor Alistair Darling announced a temporary VAT cut of 2.5pp.

(a) Draw the budget constraint before and after the VAT cut in the present period.

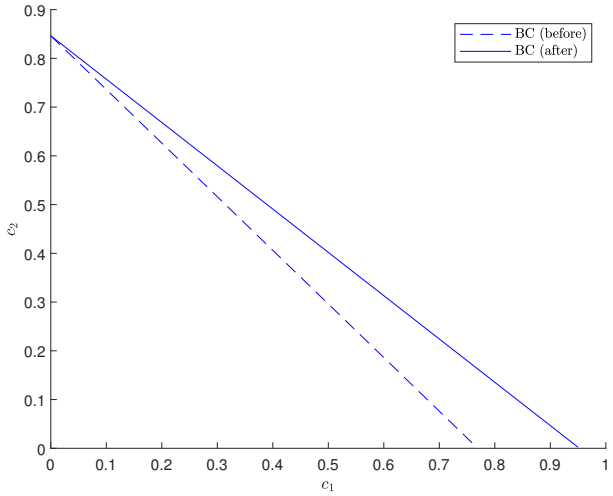
Suggested Answer

Rearrange the budget constraint:

$$c_2 = \frac{1+r_2}{1+\nu_2}\Big(\bar{y} - (1+\nu_1)c_1\Big),$$

such that the y-axis intercept, $\frac{1+r_2}{1+\nu_2}\bar{y}$, will not change , but the x-axis intercept will increase, from $\frac{\bar{y}}{1+\nu_2}$ to $\frac{\bar{y}}{1+\nu_1}$. The (absolute) slope of the budget constraint falls from $(1+r_2)$ to $(1+r_2)\frac{1+\nu_1}{1+\nu_2}$.

Figure 1: Change in VAT



Notes: After VAT changes, $\bar{y} = 1$, $r_2 = 0.1$, $\nu_1 = 0.1$, $\nu_2 = 0.2$.

[3 marks]

(b) Analyse the likely impact on consumption in both periods. You may assume consumption is a normal good.

Suggested Answer

The optimal solution for the household intertemporal consumption choice problem will set:

$$MRS_{c_1,c_2} = (1 + r_2)\frac{1 + \nu_1}{1 + \nu_2},$$

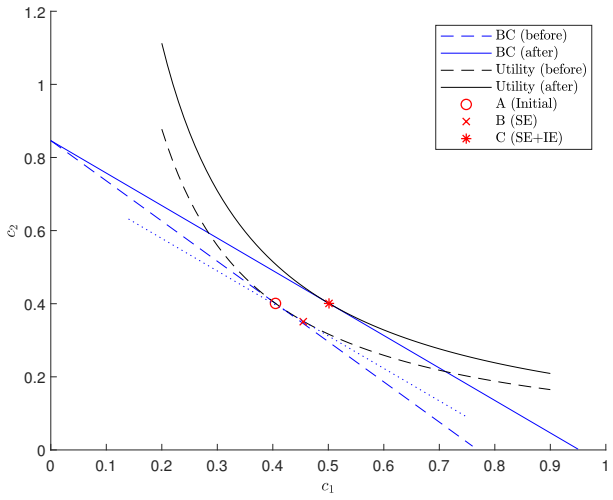
such that the marginal rate of substitution between consumption in period-1 and period-2, MRS_{c_1,c_2}, is set equal to the marginal rate of transformation (after accounting for tax differentials), represented as the slope of the budget constraint.

As the right-hand side will necessarily decrease after the VAT cut in the present period, the value of current consumption in terms of future consumption becomes relatively larger. This makes the consumer demand more goods today and fewer in the future, c_1 increases while c_2 falls. This is known as the **substitution effect**, resulting from the change in VAT (analogy here with an effective change in relative prices). This is shown as the movement between points A and B in Figure 2.

A cut in VAT also shifts the budget constraint outwards. This has a positive **income effect** on consumption. We would therefore expect the consumer to demand more goods in both periods, c_1 and c_2 increase. This is shown as the movement between points B and C in Figure 2.

Overall the impact of the VAT cut is clearly to increase current consumption, but the overall impact on future consumption is ambiguous.

Figure 2: Change in VAT, SE and IE



Notes: Utility assumed to be of form $\ln c_1 + \beta \ln c_2$, where $\beta = 0.9$ is set.

[4 marks]

A more realistic model would also incorporate credit constraints, in the household problem. Assume, due to frictions in credit markets, consumption may be at most $\tau\bar{y}$ in the current period, where $\tau \in (0, 1)$.

(c) Illustrate how a change in the credit constraint, τ, may reduce the efficacy of attempts to stimulate current consumption through a VAT cut.

Suggested Answer

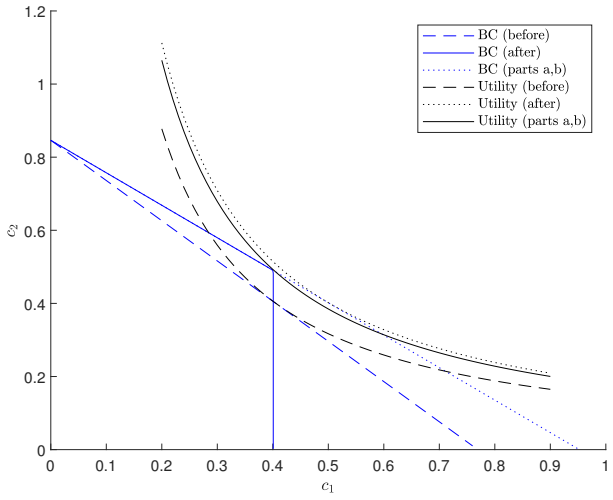
Initially, assume that $\tau \geq \frac{1}{1+\nu_2}$, such that the credit constraint does not impact the initial budget constraint.

Now, assume the credit constraint tightens, such that $\tau' < \frac{1}{1+\nu_1}$. The new budget constraint is therefore 'kinked' at the point $\tau'\bar{y}$. For illustrative purposes it is useful to assume the credit constraint tightens to precisely the initial point of current consumption, c_1. Clearly, although the budget constraint is pushed outwards, current consumption may not increase.

Instead, households consume at the 'kink', save the increase in current post-tax income and consume more in period 2.

The VAT policy is entirely ineffective at increasing current consumption and utility is strictly lower in this case.

Figure 3: Change in VAT and credit constraints



Notes: Utility assumed to be of form $\ln c_1 + \beta \ln c_2$, where $\beta = 0.9$ is set.

[5.5 marks]

A.3 Consider a real business cycle setup with private consumption and government expenditure. Assume that there is no investment and the economy is closed.

(a) Illustrate the effect of a (lump-sum) tax-financed permanent expansion in government spending on output and on the real interest rate in the context of an intertemporal macroeconomic model. Explain intuitively and use graphs to illustrate your answer.

Suggested Answer

In this question we have the following equilibrium condition:

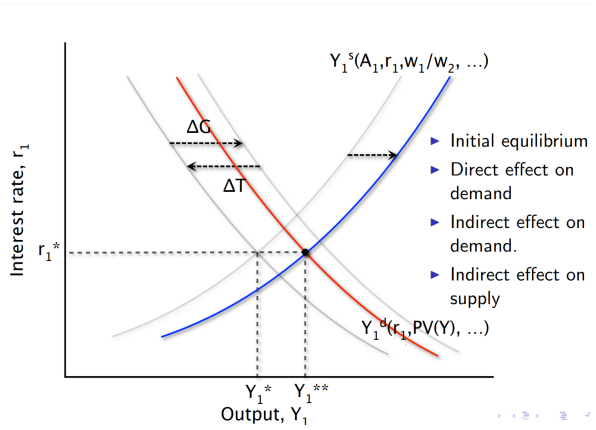
$$C(w_1(1-\tau_1)\ell_1 - T_1, ...) + G_1 = Y^d = Y^s\left(A_1, r_1, \frac{w_1}{w_2}, ...\right),$$

with $\tau_1 = 0$ and $T_1 \neq 0$. There are a number of effects to consider:

1. Firstly, in a **direct effect** demand increases by the rise in spending, ΔG.
2. Secondly there will be an **indirect effect** on demand, as taxes must rise to fund higher government consumption. A the expansion is permanent the present value of lifetime consumption must fall by $-\Delta T = -\Delta G$. Again, as the effect is permanent, the MPC of this fall will be 1 (cf. Friedman Permanent Income Hypothesis).
3. Third, the lump-sum nature of taxes carries a wealth effect on labour supply. Leisure is assumed to be a **normal good**, such that an increase in taxation (fall in income) will reduce leisure, and increase labour supply. This effect expands aggregate supply.
4. Finally, the expansion of aggregate supply will have a small positive impact on the level of household wealth. Aggregate demand therefore shifts out, slightly. In a close economy with no investment, this shift matches the shift in aggregate supply, such that the real interest rate is unchanged.

As a consequence, output increases. Intuitively, as the shock is permanent, it does not distort intertemporal allocations and the real interest rate is unchanged.

Figure 4: Permanent Change in Government Spending



[8 marks]

(b) Now suppose that, instead of lump-sum taxes, the government must use distortionary labour income taxes to finance its expansion in spending. How does this change alter you answer above? Explain intuitively and use graphs to illustrate.

Suggested Answer

Here $\tau_1 \neq 0$ and $T_1 = 0$.

To answer this question, use part (a) as a starting point. Parts (1) and (2), above, will remain unchanged. But note how a change from a lump-sum to a distortionary tax will alter the allocation. A lump-sum tax has wealth effects on labour supply, but not substitution effects. However, a distortionary tax also has a substitution effect. The substitution effect of an increase in τ_t will encourage workers to supply less labour today, as the relative returns to work are lower. If the model is such that the income and substitution effects exactly cancel each other out (e.g. $u(c) = \ln c$), then fiscal policy will be neutral, engendering no change in output (i.e. Y_1^* will be the equilibrium). Policy will remain expansionary if $|WE| > |SE|$ (but less expansionary than in part (a) if $SE < 0$), and will be contractionary if $|WE| < |SE|$.

[4.5 marks]

A.4 On 22nd January 2015, the European Central Bank announced that it would expand its asset purchase programme to include euro area government bonds, along with covered bonds and asset-backed securities. The combined monthly asset purchases were announced to amount to €60bn. On that day, the euro depreciated against the US dollar by 1.5%.

(a) Could this be consistent with the asset market model of the exchange rate. Explain.

Suggested Answer

Yes.

The asset market model may be summarised by the UIP relationship:

$$(1 + i_t) = (1 + i_t^*)\frac{\mathbb{E}_t[e_{t+1}]}{e_t},$$

and the LM relationship:

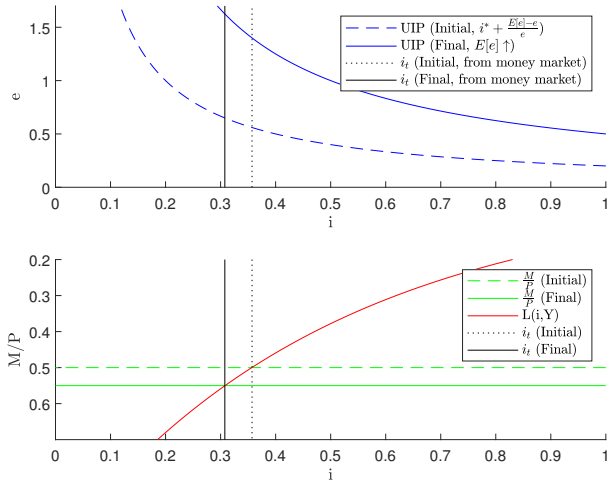
$$\frac{M_t}{P_t} = L(i_t, Y_t),$$

Upon the announcement of monetary stimulus, $M_t \uparrow$, which will have an **expectations effect** as rational agents know that in the long run $\hat{M} = \hat{e} = \hat{P}$. Therefore $\mathbb{E}[e_{t+1}] \uparrow$. This leads to a currency depreciation today, $e_t \uparrow$. The UIP curve shifts upwards, causing an exchange rate depreciation for any given level of nominal interest rate today, i_t.

In addition, $M_t \uparrow$ will also have an associated **liquidity effect**, which reduces i_t. Again, this will lead to an exchange rate depreciation $e_t \uparrow$. This arises through an expansion of the money supply, while demand for real money balances is unchanged.

Credit should be given if students note that the depreciation on 22nd January 2015 was solely a result of the expectations effect, as purchases were not carried out on this date.

Figure 5: Asset Market Model



[5 marks]

(b) On the same day, concern grew that an anti-austerity party would take power in the Greek elections, which were held on 25th January 2015. Explain how the asset market model can be augmented to account for the effects of political uncertainty and risk. To what extent does the increased political uncertainty on 22nd January 2015 reinforce or reverse the exchange rate effects discussed in part (a)

Suggested Answer

Political risk can be captured with a simple augmentation of the UIP relationship, which allows for imperfect asset substitutability. (Credit should be given to students who note that this is a more realistic depiction of arbitrage across international asset markets. The UIP relationship, in its unaugmented form, does not hold empirically). In equilibrium the UIP condition may be given as:

$$i_t = i_t^* + \mathbb{E}_t[\hat{e}_t] + \rho_t,$$

where ρ_t represents a time-varying risk premium.

Political uncertainty and risks should increase this premium and therefore contribute towards a further depreciation of the euro on this date.

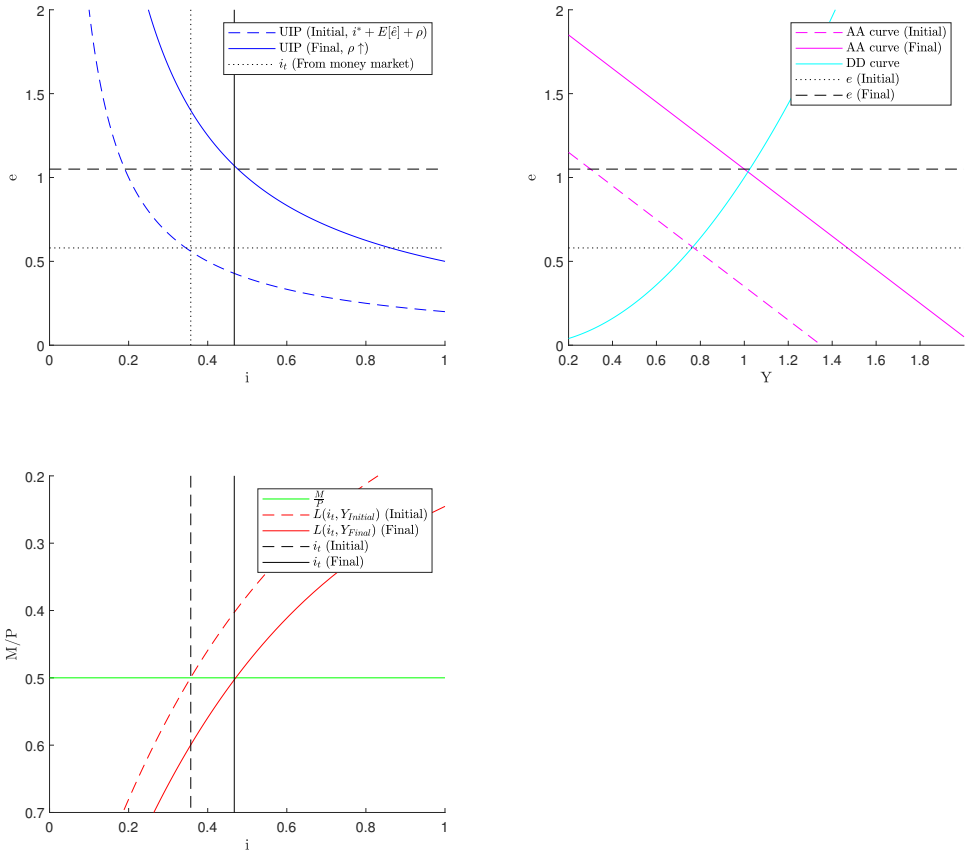
[2.5 marks]

(c) Using the DD-AA model, assess how an increase in political uncertainty and risk influences macroeconomic outcomes. Explain and evaluate your answer.

Suggested Answer

1. As discussed above, an increase in political uncertainty increases the risk premia, $\rho \uparrow$, and should lead to the UIP curve shifting upwards. This is shown in the first panel of Figure 6.
2. This increases the equilibrium level of the exchange rate (e depreciates) consistent with the FX market clearing. This shifts the AA curve outwards (for a *given* level of y). Shown in the right hand panel of Figure 6.
3. At the original level of the nominal interest rate, we have a disequilibrium. The new level of the exchange rate is 'too high' with $AA < DD$.
4. We move along the AA and DD curves to reach a new equilibrium with a higher level of output and real interest rate The impact on the nominal exchange rate is ambiguous, but likely to be positive (e depreciates). To show this general equilibrium effect with a higher level of output, a shift of the $L(i, Y)$ is required, and shown in the bottom panel of Figure 6.

Figure 6: DD-AA Model



The best answers will also seek to incorporate an increase in risk into the DD curve. This may arise through a fall in consumption and investment, when

faced with greater risk.
[**5 marks**]

Section B Solutions

B.1 Consider a price-taking representative agent who faces the following optimisation problem:

$$\max_{c_1,c_2,b_2,\ell_1,\ell_2} \{\ln c_1 + \ln \ell_1 + \beta(\ln c_2 + \ln \ell_2)\},$$

subject to:

$$\begin{aligned} c_1 + b_2 &= w_1(1-\ell_1) - T_1, \\ c_2 &= w_2(1-\ell_2) + b_2(1+r_2) - T_2, \end{aligned}$$

where c_t denotes consumption, ℓ_t leisure, b_t savings, T_t lump-sum taxes, w_t the real wage, r_t the real interest rate, and β the intertemporal discount factor ($0 < \beta < 1$). The subscript $t = 1, 2$ denotes the time period.

(a) Derive the agent's intertemporal budget constraint. Give an economic interpretation of the result.

Suggested Answer

The intertemporal budget constraint may be calculated by eliminating household savings, b_2 from the period budget constraints. Rearranging:

$$\begin{aligned} c_1 + b_2 &= w_1(1-\ell_1) - T_1, \\ b_2 &= \frac{c_2 - w_2(1-\ell_2) + T_2}{1+r_2}, \end{aligned}$$

Hence:

$$c_1 + \frac{c_2 - w_2(1-\ell_2) + T_2}{1+r_2} = w_1(1-\ell_1) - T_1,$$

and therefore:

$$c_1 + \frac{c_2}{1+r_2} = w_1(1-\ell_1) - T_1 + \frac{w_2(1-\ell_2) - T_2}{1+r_2},$$

which states that the net present value of consumption (LHS) must equal the net present value of income, after taxation (RHS). Quantities are discounted by the market real interest rate.

[4 marks]

(b) Find the optimality conditions for c_1, c_2, b_2, ℓ_1 and ℓ_2. Derive the intertemporal Euler equation for consumption, and the intratemporal (i.e. within period) Euler equation characterising the optimal trade-off between consumption and leisure. Give an intuitive explanation of these Euler equations.

Suggested Answer

The problem may be set up as a Lagrangian:

$$\max_{c_1,c_2,b_2,\ell_1,\ell_2} \left\{ \ln c_1+\ln \ell_1+\beta(\ln c_2+\ln \ell_2)+\lambda\Big(w_1(1-\ell_1)-T_1+\frac{w_2(1-\ell_2)-T_2}{1+r_2}-c_1-\frac{c_2}{1+r_2}\Big)\right\},$$

where λ is the Lagrange multiplier associated with marginally violating the intertemporal budget constraint. The associated first order conditions necessary for an optimal solution are therefore:

$$\begin{aligned}
\frac{1}{c_1} &= \lambda, \\
\frac{\beta}{c_2} &= \frac{\lambda}{1+r_2}, \\
\frac{1}{\ell_1} &= \lambda w_1, \\
\frac{\beta}{\ell_s} &= \frac{\lambda w_2}{1+r_2},
\end{aligned}$$

where the final equation characterising the equilibrium of the household's problem is the intertemporal budget constraint:

$$c_1 + \frac{c_2}{1+r_2} = w_1(1-\ell_1) - T_1 + \frac{w_2(1-\ell_2)-T_2}{1+r_2},$$

By eliminating λ from the problem, we can determine the equilibrium in terms of four equations:

$$\begin{aligned}
\frac{1}{c_1} &= \frac{\beta(1+r_2)}{c_2}, \\
\frac{1}{c_1} &= \frac{1}{w_1\ell_1}, \\
\frac{1}{c_2} &= \frac{1}{w_2\ell_2}, \\
c_1 + \frac{c_2}{1+r_2} &= w_1(1-\ell_1) - T_1 + \frac{w_2(1-\ell_2)-T_2}{1+r_2},
\end{aligned}$$

where the first equation is the intertemporal Euler equation. This describes the trade-off faced by households between consumption in period 1 and period 2. In an optimal solution the marginal benefit of an additional unit of consumption is equalised in both periods. The second and third equations, above, are the intratemporal Euler equations which describe the trade-off between consumption and leisure within each period. Again, in an optimal solution the

marginal benefit of an extra unit of consumption is set equal to the marginal benefit of an additional unit of leisure, evaluated at the prevailing market wage.

The optimality condition for b_2 should either be given explicitly at this stage, or simply stated that this may be calculated from the period budget constraints, once the optimal solution for c_t, and ℓ_t has been found using the four equations above.

A graph may be helpful in providing additional explanation here.

[7 marks]

Assume that the economy is closed and that there is no investment. So the GDP identity is given by $y_t = c_t + g_t$, where g_t denotes government purchases, which are exogenous, and y_t denotes aggregate output, which is equal to $y_t = w_t(1 - \ell_t)$. Suppose that $w_t = A_t$, where A_t represents productivity in period $t = 1, 2$. In addition, assume that the government runs a balanced budget such that $T_t = g_t$.

(c) Solve for the equilibrium level of output y_t in terms of A_t, g_t and r_t for $t = 1, 2$.

Suggested Answer

In the first step use the equations above to calculate current consumption, c_1, in terms of variable which are exogenous from the household's perspective:

$$\begin{aligned} c_1 + \frac{\beta(1+r_2)}{1+r_2}c_1 &= w_1 - c_1 - T_1 + \frac{w_2 - \beta(1+r_2)c_1 - T_2}{1+r_2}, \\ 2(1+\beta)c_1 &= w_1 - T_1 + \frac{w_2 - T_2}{1+r_2}, \\ c_1 &= \frac{1}{2(1+\beta)}\Big(w_1 - T_1 + \frac{w_2 - T_2}{1+r_2}\Big), \end{aligned}$$

which says that consumption is a constant fraction of the net present discounted value of life-time wealth (after taxation). This result is unsurprising given the log-functional form of the utility function (Income and Substitution Effects cancel).

In the second step, we impose general equilibrium conditions ($w_1 = A_1$, $w_2 = A_2$, $T_1 = g_1$ and $T_2 = g_2$) on this equation.

$$c_1 = \frac{1}{2(1+\beta)}\Big(A_1 - g_1 + \frac{A_2 - g_2}{1+r_2}\Big),$$

the equation for consumption in the second period may be written down immediately, given the Euler equation:

$$c_2 = \beta(1+r_2)c_1 = \frac{\beta(1+r_2)}{2(1+\beta)}\Big(A_1 - g_1 + \frac{A_2 - g_2}{1+r_2}\Big),$$

and the two general equilibrium conditions we seek are therefore:

$$\begin{aligned} y_1 = c_1 + g_1 &= \frac{1}{2(1+\beta)}\Big(A_1 - g_1 + \frac{A_2 - g_2}{1+r_2}\Big) + g_1, \\ y_2 = c_2 + g_2 &= \frac{\beta(1+r_2)}{2(1+\beta)}\Big(A_1 - g_1 + \frac{A_2 - g_2}{1+r_2}\Big) + g_2. \end{aligned}$$

[6 marks]

(d) Given our assumption of a closed economy, the general equilibrium condition for bonds states that $b_2 = 0$. Using this information and your optimality condition for b_2 write the real interest rate $1 + r_2$ as a function of A_t and G_t for $t = 1, 2$. Combine this with your answer to part (c) to rewrite the equilibrium level of y_t in terms of A_t and g_t only, for $t = 1, 2$.

Suggested Answer

The optimality condition for b_2 uses the period budget constraint and is given as:

$$\begin{aligned} b_2 &= w_1(1 - \ell_1) - T_1 - c_1, \\ 0 &= A_1 - g_1 - \frac{1}{(1+\beta)}\Big(A_1 - g_1 + \frac{A_2 - g_2}{1 + r_2}\Big), \end{aligned}$$

where the second equation imposes the optimality conditions for consumption and leisure, aggregate accounting equations and the bond market clearing condition. By rearranging we observe:

$$1 + r_2 = \frac{A_2 - G_1}{\beta(A_1 - G_1)}.$$

Combining this with the above will result in:

$$\begin{aligned} y_1 &= \frac{1}{2}A_1 + \frac{1}{2}g_1, \\ y_2 &= \frac{1}{2}A_2 + \frac{1}{2}g_2. \end{aligned}$$

[5 marks]

(e) Derive the fiscal multiplier dy_1/dg_1 for a permanent increase in g_1. Provide an intuitive explanation of the results.

Suggested Answer

The fiscal multiplier may be written down as:

$$\frac{dy_1}{dg_1} = \frac{1}{2},$$

which is clearly comprised of two components. The first component is the direct effect of greater fiscal spending in the current period $dg_1/dg_1 = 1$. Higher government spending will increase aggregate output by definition. However, as higher government spending must be financed by greater taxation in the current period, this will lead to a lower level of consumption $dc_1/dg_1 = -\frac{1}{2} < 0$. The households wealth has fallen by dg_t units. Optimally they choose to spread this evenly across lower consumption and lower leisure (working more). Given the even weight in the utility function both consumption and leisure fall by $\frac{1}{2}dg_t$ units.

Households would also want to smooth consumption across periods, such that the fall in consumption and the 'burden of additional taxation' is smoothed over time. However, in general equilibrium, as $b_2 = 0$ must be maintained there is no way to do this. Instead the real interest rate adjusts to ensure the full impact of the change in government spending is felt in the period 1.

[3 marks]

B.2 Consider the Bernanke-Blinder extension to the ISLM model. Banks are assumed to hold bonds B, loans, L, and reserves, R, as assets, and have deposits, D, as liabilities, so that the representative bank's balance sheet is:

$$B + L + R = D.$$

Reserves are equal to the legal minimum reserve requirement $R = \tau D$, where $\tau = \frac{1}{3}$. This yields the supply of deposits in the money market:

$$D^s = 3R.$$

The demand for deposits is given by the traditional money demand equation

$$D^d = Y - \frac{1}{2}i_B,$$

where Y is real aggregate output and i_B is the bond interest rate. The supply of loans is described by:

$$L^s = \frac{3}{4}(D - R).$$

The demand for loans is described by:

$$L^d = Y - \frac{1}{4}(i_L - i_B).$$

where i_L is the loan interest rate. The goods market equilibrium is described by:

$$Y = 60 - \frac{1}{4}i_L - \frac{1}{4}i_B.$$

(a) Derive the equilibrium bond interest rate i_B in the money market in terms of output, Y and reserves, R, and the equilibrium loan interest rate i_L in the loan market in terms of output, Y, reserves R and the equilibrium bond interest rate, i_B. Give an intuitive explanation.

Suggested Answer

Equilibrium in the money market requires:

$$\begin{aligned} D^d &= D^s, \\ Y - \frac{1}{2}i_B &= 3R, \\ i_B &= 2Y - 6R, \qquad \text{(LM curve)} \end{aligned}$$

Where the final rearrangement puts the equilibrium in the form of the LM curve. This clearly displays a positive relationship between i_B and Y. Expansionary monetary policy ($R \uparrow$) would shift the LM curve to the right.

$$\begin{aligned} L^d &= L^s, \\ Y - \frac{1}{4}(i_L - i_B) &= \frac{3}{4}(3R - R), \\ i_L &= 4Y - 6R + i_B, \end{aligned}$$

Equilibrium in the loan market arises when:

$$\begin{aligned} L^d &= L^s, \\ Y - \frac{1}{4}(i_L - i_B) &= \frac{3}{4}(3R - R), \\ i_L &= 4Y - 6R + i_B, \end{aligned}$$

Again, this clearly displays a positive relationship between i_L and Y. Expansionary monetary policy ($R \uparrow$) would cause a fall in the loan interest rate.
[3 marks]

(b) Derive output, Y, in terms of reserves, R, and the equilibrium bond interest rate, i_B, such that there is equilibrium in both the goods market and the loan market. Give an intuitive explanation.

Suggested Answer

Equilibrium in the loan market may be combined with equilibrium in the goods market:

$$\begin{aligned} Y &= 60 - \frac{1}{4}\Big(4Y - 6R + i_B\Big) - \frac{1}{4}i_B, \\ 2Y &= 60 + \frac{6}{4}R - \frac{1}{2}i_B, \\ Y &= 30 + \frac{3}{4}R - \frac{1}{4}i_B, \\ i_B &= -4Y + 120 + 3R, \qquad \text{(CC curve)} \end{aligned}$$

where the final rearrangement put the equation into the form of the CC (consumption and credit) curve. This clearly displays a negative relationship between i_B and Y. Expansionary monetary policy ($R \uparrow$) would shift the CC curve to the right.

[2 marks]

(c) Suppose the central bank increases the level of reserves from $R = 10$ to $R' = 12$. Compute the initial and new equilibrium level of output, Y, and the bond interest rate, i_B. Illustrate the effect graphically and provide an economic explanation.

Suggested Answer

Analytical solution:

In equilibrium, LM and CC curves intersect. This gives two equations in two unknowns.

$$i_B = 2Y - 6R, \qquad \text{(LM curve)}$$
$$i_B = -4Y + 120 + 3R, \qquad \text{(CC curve)}$$

such that,

$$-4Y + 120 + 3R = 2Y - 6R,$$
$$Y = 20 + \frac{3}{2}R,$$

and hence

$$i_B = 2Y - 6R,$$
$$i_B = 40 - 3R,$$

The full solution are therefore:

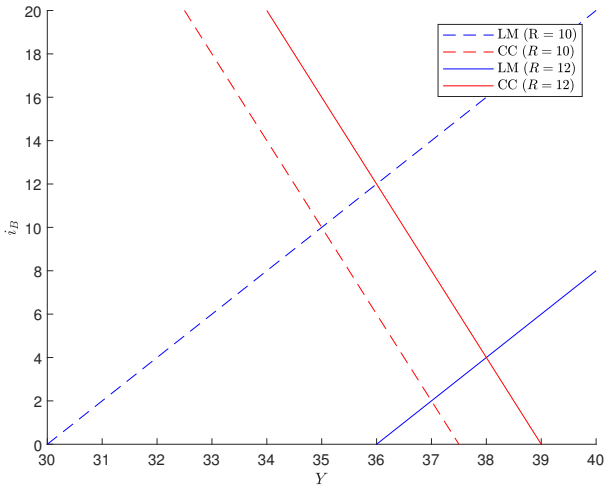
R	Y	i_B
10	35	10
12	38	4

Graphical solution: Both LM and CC curves shift to the right as a result of expansionary monetary policy. This increases output (unambiguously), but has an ambiguous impact on the bond interest rate, i_B. Given the parameters we observe a fall in the bond interest rate. This is shown in Figure 7.

We conclude that the impact on i_B of the Keynesian **interest rate channel** (shift in LM curve) is larger than the **bank lending channel** (shift in CC curve), in this economy.

Students expected to explain both channels of transmission.

Figure 7: Bernanke-Blinder Model



[10 marks]

(d) Suppose that the central bank subsequently raises the required reserve ratio to $\tau = \frac{1}{2}$ to address liquidity problems in the banking sector. Explain how this affects the equilibrium level of output, Y and the bond interest rate i_B. Provide a graphical illustration.

Suggested Answer

When the reserve requirement ratio, τ, increases both the LM and CC curves change. Following the mathematics of the previous answers we have:

$$i_B = 2Y - 4R, \qquad \text{(LM curve)}$$
$$i_B = -4Y + 120 + 6R, \qquad \text{(CC curve)}$$

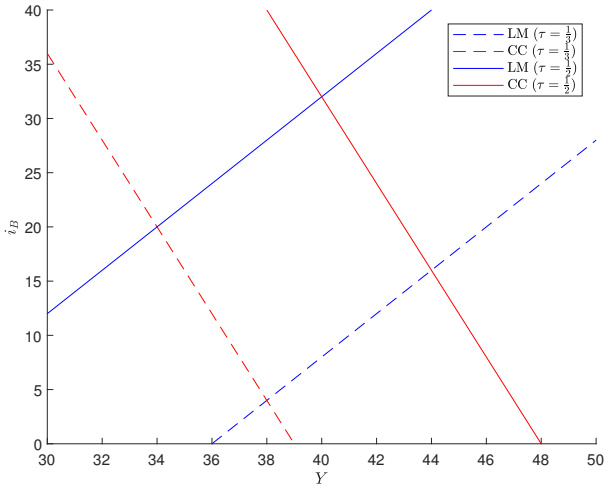
such that the LM curve and the CC curve both shift up vertically, the LM curve by $2R$ units and the CC curve by $3R$ units. This will unambiguously increase the price, i_B, while the impact on the level of output is less clear. The new equilibrium satisfies:

$$Y = 20 + \frac{5}{3}R,$$
$$i_B = 40 - \frac{2}{3}R,$$

such that

τ	R	Y	i_B
$\tau = \frac{1}{3}$	12	38	4
$\tau = \frac{1}{2}$	12	40	32

Figure 8: Bernanke-Blinder Model, change in τ



[10 marks]

Section C Solutions

C.1 On 22nd December 1994, the Mexican peso depreciated by about 21% against the US dollar at the start of what became known in financial markets as the 'Tequila crisis'. Using examples, discuss what could be the causes of a currency crisis.

Suggested Answer

We study three potential causes of currency crises in class:

- Bad macroeconomic fundamentals (First generation models). In the Krugman model, a fixed exchange rate combined with monetary financing of government budget deficit results in a currency being attacked when shadow exchange rate equals exchange rate peg. Examples include the Latin-American crises of the 1980s.
- Self-fulfilling crises (Second generation models). An expectation of devaluation could raise the interest rate of an economy by so much that the currency needs to be devalued. Typically economic models in this classification have multiple equilibria. Examples include the EMS crises in 1992. Students may cite work by Obstfeld.
- Financial fragility (Third generation models). Structural weaknesses in the financial system - potentially due to: poor supervision and regulation; short-term and foreign-currency denominated debt - can generate conditions for a currency crisis. Examples include the South-East Asian crisis in 1997. This may lead to a perpetually worsening cycle of poor economic performance which further weakens the financial health of the economy.

Answers should refer to each of these in some depth, explaining at least one in greater detail.

[25 marks]

C.2 Since the start of 'quantitative easing' (QE) by the Bank of England in March 2009, banks' reserves at the Bank of England have risen by about £240bn and the monetary base has more than tripled, whereas M4 has remained almost unchanged. Analyse what the likely effect of QE would have been on reserves, the monetary base and M4 if banks had used it to fully expand their lending. Aside from the bank lending channel, discuss alternative theoretical channels through which QE could have been effective in the UK.

Suggested Answer

QE through purchase of £375bn gilts (as of March 2015) raises reserve balances by same amount.

Lending by banks leads to increase in deposits, which increases money supply according to money multiplier ($\Delta M = m\Delta R$), but has no direct effect on reserve balances banking system, except for additional money withdrawn in cash (according to cash ratio), which reduces R, explaining $\Delta R <$ £375bn.

In practice, the increase in R has had little effect on M4 due to decline in the money multiplier m, which could be explained by rise in excess reserve ratio in response to financial crisis.

Besides the bank lending channel of monetary transmission, QE also impacts the economy through an asset price channel of transmission. This arises as QE causes large declines in longer term yields. There is strong empirical evidence exists in favour of these channels.

[25 marks]

C.3 The United States regularly extends the duration of unemployment benefits during recessions. Discuss, in the context of models of the labour market, how such an extension may affect the behaviour of the unemployment rate, and possible consequences on the subsequent recovery.

Suggested Answer

This question should be discussed in the context of the Shapiro-Stiglitz model and McCall's search model.

In the Shapiro-Stiglitz model, the rise in unemployment insurance (UI) will shift the NSC curve up. This will lead to a rise in unemployment and higher wages.

In McCall's search model, increased UI will lead to lower labour supply and a lower job finding rate. This will increase the unemployment rate. A lower job finding rate will shift the u_{ss} up, and slow down the transition back to the long run equilibrium.

Further discussions are desirable (e.g. standard classical shift in labour supply with sticky wages).

[**25 marks**]

C.4 A pervasive argument in the debate concerning the effectiveness of fiscal policy is of the type: "A dollar spent by the government is a dollar taxed, in the present or in the future. So, government spending cannot stimulate the economy, let alone private demand." Discuss to what extent this argument is faulty, and to what extent it is correct.

Suggested Answer

The argument refers to Ricardian Equivalence, which itself is related to the Permanent Income Hypothesis. The argument is faulty in the following sense: A one dollar temporary rise in public spending must be taxed by an equal amount. True. But the reduction in permanent income of a one dollar increase in taxes is extremely small.

Thus, private demand is only crowded out by a small amount, and the government may stimulate the economy.

However the argument is also true in the following sense: Suppose that one dollar spent raises current income also with one dollar. Then the reduction in permanent income due to taxation, and the rise in permanent income due to spending is a wash.

As a consequence, private demand and private consumption is unchanged, although output has increased.

Some students may wish to discuss distortionary taxation - this is fine, if done well.

[**25 marks**]