QUEEN'S UNIVERSITY

FACULTY OF ARTS AND SCIENCE

DEPARTMENT OF ECONOMICS

Economics 222 A&B
Macroeconomic Theory I

Suggested answers

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Part A (Short Questions)

Question A.5: The AS-AD Model and Business Cycles

This question asks you to explain *carefully* the key differences between Keynesian and Classical thought on the topic of business cycles, using as a framework the *AS-AD* model with a horizontal *SRAS* curve. Assume that we are initially in a long-run equilibrium, and that output is at its full-employment level $Y = \overline{Y}$. Consider a decrease in aggregate demand (i.e., an adverse demand shock).

a) [6 MARKS] Illustrate the situation graphically in the *AS-AD* framework, depicting both the short-run and the long-run equilibria. Explain any shifts in curves, making sure of referencing how underlying markets are affected. Which effects are deemed temporary, which are deemed long-lasting, and by whom respectively?

A decrease in aggregate demand shifts the *AD* curve to the left, thus causing the price level to remain constant in the short run (at least with a horizontal *SRAS* curve), and output to lie below its full-employment level. This is the short-run effect, according to the Keynesians. The long-run effect is for prices to fall (*SRAS* shifts down) so that full-employment is restored. Keynesians argue that prices may be fairly sticky and rigid in the short- and medium-run, hence causing this output gap to persist, and thus unemployment to be also persistently high due to the fall in aggregate demand. This informs in turn their policy recommendations, cf. b). The Classics, on the other hand argue that the adjustment in prices is quick, and hence there are no persisting shortages and surpluses in any markets, including the labour market.

b) [4 MARKS] What is the appropriate policy response advocated by each school of thought in reaction to such a contraction? Why? Express it graphically.

Classics argue that *laissez-faire* is an appropriate policy response as the market is quickly self-adjusting. This occurs through a decrease in the price level, thus causing the *SRAS* curve to shift downwards to restore full-employment output. Keynesians argue that due to rigidities in prices and wages, it is necessary to stimulate the economy so as to make use of the underutilized productive resources (e.g., inputs: capital and labour). This is done through expansionary fiscal and monetary policies that cause aggregate demand to increase, and thus the *AD* curve to shift to the right until full employment is restored, while the price level remains unchanged as a result.

Question A.6: Closed Economy *IS-LM-FE*

Consider a one-time increase in the nominal money supply M of 10% within the closed economy *IS-LM-FE* framework. Suppose that we initially are in a long-run equilibrium at full-employment output (i.e., $Y = \overline{Y}$).

a) [5 MARKS] Illustrate the short-run effects of this policy within the *IS-LM-FE* framework.

Provide an explanation for any shifts, and carefully explain the *transition* by referring to the *monetary channel*.

An increase in the nominal money supply of 10% causes the interest rate to fall for a constant money demand. This is so as people want to exchange their newly acquired money balances for other (non-monetary) assets to re-balance their portfolios, which pushes up the price of non-monetary of non-monetary assets and reduces their yield, which happens to be the interest rate. This causes the LM curve to shift downwards (rightwards), thereby increasing output beyond the full-employment level and (as predicted earlier in the asset market equilibrium) lowering the equilibrium interest rate for this economy. The transition happens along the LM curve (as the asset market clears the fastest), through the monetary channel, that is:

$$\Delta M \rightarrow \Delta r \rightarrow \Delta I, \Delta C \rightarrow \Delta Y$$

The decrease in the interest rate causes the goods market to adjust to a new equilibrium through a change in investment and consumption expenditures (and therefore savings), thus increasing output. This increase in current income in turn increases demand for money, which increases the equilibrium interest rate and adjusts savings and investment until the goods market clears. This is a description of the movement upward along the LM curve, until the point where the goods market is in equilibrium and we are back on the IS curve (the intersection between both curves, that is the short-run equilibrium).

b) [5 MARKS] Illustrate the long-run effects of this policy within the *IS-LM-FE* framework. What is this policy's effect on output? What is its *precise* impact on prices? Name the phenomenon at work here.

In the long run, as output is above its full-employment level and resources (i.e., labour and capital) are being over-utilized, this creates an upward pressure on prices, such that real money balances M/P must be restored to their initial level. This causes the LM curve to shift upwards to its original position, and the reverse transitional process to the one described in a) occurs along the LM curve (a downward movement along the curve). The interest rate rises to its initial level, and output falls to its full-employment level. Since real money balances are ultimately unchanged, and M initially increased by 10%, then so must P. This is an illustration of the *neutrality of money*: money growth ultimately only leads to inflation (growth in prices), and has no real effects (real output, real wages, etc. are left unchanged). There is again a disagreement between Classical and Keynesian economists as to whether monetary can be effective at all: this centers on the speed at which prices change. As it is described above however, monetary policy would appear to be have real effects in the short run.

Question A.7: The Phillips Curve

Suppose that an economy is characterized by the expectations-augmented Phillips curve $\pi = \pi^e - h(u - \overline{u})$, where $h > 0$ and $\overline{u}$ is the natural rate of unemployment.

a) [4 MARKS] Using the expectations-augmented Phillips curve model above, explain the effects of a *one-time increase* in the money growth rate g_M (e.g., from 2% this year to 3% next year and thereafter) on inflation and output in the short and the long run. Be sure to support your answer with diagrams.

The increase in the growth rate of money causes it to increase above inflation (the growth rate in prices) in the short run, which triggers an increase in output, as predicted by the dynamic aggregate demand curve. In terms of the short-run Phillips curve, this means that (by Okun's law), an increase in the growth rate of output from zero to some positive number reduces unemployment, which causes in turn inflation to increase: this characterizes a movement upward along the original Phillips curve. Actual inflation now exceeds expectations of inflation, which must mean that inflation expectations increase, therefore causing the short-run Phillips curve to shift upwards. This process continues until a new long-run equilibrium, where $\pi = g_M = 0.03$ (rather than $\pi = g_M = 0.02$ as was initially the case) and $u = \overline{u}$, is reached. (Characterizing the transition requires specifying the expectation-formation process, something the question doesn't mention; it is therefore not required to talk explicitly about it. Assuming adaptive expectations, however, the economy would transition to the new long-run equilibrium by first overshooting the natural interest rate and long-run rate of inflation, thus passing many "turning points", thus producing the typical textbook spiral.) We are therefore at the intersection of a new short-run Phillips curve (higher than the original one), and the vertical long-run Phillips curve. This leads us to conclude that an increase in money growth only results in higher inflation in the long run, while it has both real effects *and* inflationary effects in the short run.

b) [4 MARKS] Suppose that the central bank tries to maintain the unemployment rate below the natural rate by *persistently* increasing the growth rate of money (e.g., from 2% this year, to 3% next year, to 4% the year after, etc.). What would happen? Be sure to support your answer with diagrams.

If the central bank consistently increased the rate of money growth, it would initially induce the same effect as a one-time increase in the growth rate of money: a movement upward along the Phillips curve (thus lowering unemployment and increasing inflation), which causes an upward adjustment in expectations of inflation, and results in an upward shift of the short-run Phillips curve. Yet there is now no convergence to a long-run equilibrium: as the money growth rate increases again, unemployment is further reduced at the cost of even higher inflation (another movement upward along the Phillips curve), which further increases expectations of inflation, etc. This will keep the unemployment rate below the natural rate, but only at the cost of rising inflation, which

is an *acceleration* of the *price level* – this is the basis of the *accelerationist hypothesis*, and explains why the natural rate of employment is also referred to as the *NAIRU*: the *non-accelerating* inflation rate of unemployment.

c) [2 MARKS] Explain the concept of the "sacrifice ratio".

The sacrifice ratio is the amount of output lost when the inflation rate is reduced by 1 percentage point (100 basis points). Its calculation is based on potential (full-employment) output, and growth in potential output over the period of interest, and is subject to a prediction bias.

Question A.8: Mundell-Fleming with Fixed Exchange Rates

Suppose that we are in a long-run equilibrium, such that $r = r_{for}$ (no-arbitrage, interest parity condition holds) and $Y = \overline{Y}$ (full-employment output). A country with a fixed exchange rate regime revalues its currency, that is it raises $\overline{e}_{nom}$ from $\overline{e}^1_{nom}$ to $\overline{e}^2_{nom}$.

a)[5 MARKS] Illustrate the short-run effects of this policy in an *IS-LM-FE* diagram. Explain carefully what triggers any shifts in curves, by relating them to the changes in the underlying goods and asset markets. What happens to the real exchange rate, net exports, and output?

A revaluation of the currency will have the direct effect of reducing net exports (imports increase as foreign goods become relatively cheaper for domestic customers, exports decrease because the opposite holds for foreign consumers), thus causing the *IS* curve to shift in (to the left). Output falls below its long-run, full-employment level, and the real interest rate falls such that $r < r_{for}$. Yet, this decrease in r creates arbitrage opportunities in foreign markets, which causes the fundamental value of the exchange rate to fall below its fixed value; the central bank must intervene, and reduce M (buy back the domestic currency using foreign reserves, so as to reduce its supply and raise its fundamental value up to its pegged value). This indirect effect on M results in an upward shift in the LM curve until $r = r_{for}$, which further decreases output below its full-employment level.

We thus have that the real exchange rate has increased, net exports have decreased, and output has increased in the short run.

b) [5 MARKS] Illustrate the long-run effects of this policy in the *IS-LM-FE* diagram. Again, explain carefully what triggers any shifts in curves, by relating them to the changes in the underlying goods and asset markets. What happened to the real exchange rate, net exports, and output in the long run, compared with the initial equilibrium where $\overline{e}_{nom} = \overline{e}^1_{nom}$?

In the long run, prices must adjust. A short-run equilibrium below full-employment output implies that prices must fall for the long-run equilibrium to once again be reached. This decrease in the price level P causes the LM curve to shift downwards to its original position. With $\overline{e}_{nom} = \overline{e}^2_{nom}$ and P_{for} being constant, this must mean that the real exchange $e = (\overline{e}^2_{nom} P)/P_{for}$ falls, such that

is back to its original level: the decrease in P perfectly offsets the initial increase in $\overline{e}_{nom}$. This decrease in e to its original level must restore the IS curve to its original position, through an increase in net exports. Therefore, in the long-run equilibrium, the real exchange rate and net exports have been restored to their initial level, and output is back to its full-employment level.

Part B (Long Questions)

Question B.1: Mundell-Fleming Model with Flexible Exchange Rates

Suppose that a small open economy can be represented by the following model with a flexible exchange rate:

$$C^d = 300 + 0.6(Y - T)$$

$$I^d = 175 - 350r$$

$$T = G = 400$$

$$NX = 245 - 0.1Y - 100e$$

$$\frac{M^d}{P} = Y - 85(r + \pi^e)$$

$$\pi^e = 0.20$$

$$P = 1$$

Assume initially that the economy is in a long-run equilibrium, where $e = 2$, the no-arbitrage condition $r = r_{for}$ holds, and output is at its full-employment level $Y = \overline{Y}$. Also assume here perfect capital mobility.

a) [3 MARKS] Find equations for the *IS* and *LM* curves in this economy. Keep the equation for the *IS* curve as a function of e (i.e., do not sub in values yet).

Using the income-expenditure identity, one gets:

$$Y = 880.0 + 0.5Y - 400r - 100e$$

which yields the equation for the *IS* curve:

$$r = -0.00125Y + 2.20 - \frac{1}{4}e$$

while the equation for the *LM* curve is:

$$r = -\frac{1}{85}\left(\frac{M}{P}\right) + \frac{1}{85}Y - 0.20$$

b) [5 MARKS] Assuming that $r_{for} = 0.10$, find the long-run equilibrium values of Y, C, I, and NX. Find as well the nominal money supply M which is necessary to bring about this long-run equilibrium. Finally, represent the long-run equilibrium graphically in the (r, Y) space.

Solving the above system of equations for $r = r_{for} = 0.10$ and thus $e = 2$, one finds:

$$Y = \overline{Y} = 1280$$

$$M = 1254.5$$

$$C = 828$$

$$I = 135$$

$$NX = -83$$

The usual diagram follows.

c) [6 MARKS] There is a surge in expected inflation, and now $\pi^e = 0.40$. Solve for the new *LM and IS* curves in this economy, and find the short-run equilibrium values for r, e, NX and Y. Depict the short-run equilibrium in a diagram, and explain what is at work here.
The new LM curve is given by:

$$r = -\frac{1}{85}\left(\frac{M}{P}\right) + \frac{1}{85}Y - 0.40$$

Subbing in the long-run equilibrium values for the price level and the money supply (both unchanged in the short run), one thus obtains:

$$r = -15.27647059 + \frac{1}{85}Y$$

The IS curve is still initially given by:

$$r = -0.00125Y + 2.20 - \frac{1}{4}e$$

Since we are assuming perfect capital mobility, it means that even in the short-run equilibrium $r = r_{for} = 0.10$. Substituting this in the LM curve yields Y, while substituting thereafter Y in the IS curve yields e. One thus gets:

$$Y = 1297$$

$$r = r_{for} = 0.10$$

Looking at the IS curve, the implied exchange rate is thus:

$$e = 1.915$$

and net exports are:

$$NX = -76.20$$

Looking at the original equation for the IS curve, this would imply an upward shift in the IS curve (coupled with the initial downward shift in the LM curve) due to an increase in net exports as a result of the depreciation of the currency, such that $r = r_{for}$ at the short-run equilibrium.

d) [6 MARKS] The central bank wants to avoid any change in the price level in the long run,

following the shock in part c). What policy should it implement, so that the economy moves back to the long-run equilibrium found in b) without incurring any change in P? Find the new value of the money supply M, which corresponds to the central bank's choice of policy. Then, represent the new long-run equilibrium diagrammatically, explaining the transition.

In order to find M, one simply has to look at the equation for the LM curve found in b), where $\pi^e = 0.40$, and assume that $r = 0.10$, $P = 1$ and $Y = \overline{Y} = 1280$. One therefore gets:

$$0.10 = -\frac{1}{85}M + 14.65882353$$

$$\iff M = 1237.50$$

As we would expect that the LM curve must shift upwards to reach the long-run equilibrium, this is consistent with either an increase in prices (which we do not allow) or a decrease in the nominal money supply, which is what we observe here.

In the transition to the new long-run equilibrium, the nominal money supply decreases, thus shifting the LM curve upwards, and raising $r > r_{for} = 0.10$. This creates domestic arbitrage opportunities, which increases the demand for the domestic currency relative to its supply, and causes thus an increase in e (an appreciation of the currency) to $e = 2$. This shifts in (downwards) the IS curve as NX falls (imports increase while exports decrease), until the interest rate parity is re-established. Output is back at its full-employment value. This should be represented diagrammatically.

Question B.2: Lifetime consumption

An individual lives for two periods, $t = 1$ and $t = 2$. In the first period, she is young and attends university, and hence has little revenues of her own: $e_1 = 12$. In the second period (adulthood), she earns $e_2 = 125$. She dies after the second period. She aims to smooth her consumption across time periods: her preferences are characterized by her marginal rate of inter-temporal substitution ($MRIS$), $MRIS = (11/10) \cdot (c_2/c_1)$. She also wishes to give a bequest $b = 15$ to her children. The real interest rate in this economy is given by $r = 0.10$.

a) [3 MARKS] Find the individual's budget constraint in every period. From that, find an equation for her inter-temporal budget constraint.

Here we find:

$$c_1 = e_1 - s_1$$

$$c_2 = e_2 + (1 + r)s_1 - b$$

This yields the inter-temporal budget constraint:

$$c_1 + \frac{c_2}{1+r} = e_1 + \frac{e_2 - b}{1+r}$$

in which the values for e_1, e_2, r and b can be subbed.

b) [3 MARKS] Find the individual's optimal consumption and savings in each period.

Using the optimality condition (i.e., $MRIS = (1 + r)$, the tangency condition) one finds:

$$\frac{c_2}{c_1} = \beta\,(1 + r)$$

where $\beta = 10/11$ and $(1 + r) = 11/10$, hence $c_1 = c_2$ in the optimum. Using the inter-temporal budget constraint, one therefore finds:

$$c_1 = c_2 = 58.666\bar{6}$$

This is such that:

$$s_1 = e_1 - c_1 = -46.666\bar{6}$$

and

$$s_2 = e_2 + (1 + r)s_1 - c_2$$

$$\iff b = s_2 = 15$$

c) [6 MARKS] Suppose that the interest rate decreases from $r = 0.10$ to $r = 0.05$, before the individual has made any optimal allocation decisions. Determine how this affects the individual's consumption and saving decisions. Illustrate the change of bundle graphically, identifying the total effect, decomposing it in income and substitution effects and differentiating clearly between them.

Using the procedure outlined in b), one finds:

$$c_1 = 61.16099775,\ c_2 = 58.38095240$$

Savings are now:

$$s_1 = -49.16099775,\ s_2 = b = 15$$

The usual diagram for a borrower follows.

d) [4 MARKS] Suppose that we are back at $r = 0.10$, yet the individual now also faces a *borrowing constraint* at time $t = 1$, such that $s_1 \geq 0$. Find the new constrained-optimal consumption and saving decisions in each period, given that decisions are no longer governed by the $MRIS$.

Since $s_1 \geq 0$, this means that the individual will save $s_1 = 0$ (as she would like to borrow if she were not constrained) and still have $s_2 = b = 15$. The individual's consumption in each period is now thus:

$$c_1 = 12,\ c_2 = 110$$

One therefore notices that a debt-financed transfer scheme *has* real effects on the (credit-constrained) individual described in d), such that her optimal consumption decisions are altered. From this, one can conclude that in this example with a forward-looking individual with perfect foresight, Ricardian equivalence *doesn't hold*; this is due to there being a borrowing constraint imposed on this individual.

Question B.3: Mundell-Fleming with Fixed Exchange Rates

Consider the following small open economy, with fixed exchange rates and perfect capital mobility:

$$C^d = 245 + 0.67Y$$

$$I^d = 225 - 500r$$

$$T = 0$$

$$NX = 85 - 0.07Y - 65\overline{e}$$

$$\overline{e} = 1.8$$

$$M = 600$$

$$\frac{M^d}{P} = 0.5Y - 75r$$

$$P = 1$$

Assume that the economy is initially in a long-run equilibrium, such that the no-arbitrage condition $r = r_{for}$ holds, and output is at its full-employment level $Y = \overline{Y}$.

a) [3 MARKS] Find equations for the *IS* and *LM* curves in this economy. Keep the equation for the *IS* curve as a function of G and $\overline{e}$ (i.e., do not sub in values yet).

The *IS* curve has the following equation:

$$r = -0.0008Y + \frac{111}{100} + \frac{1}{500}G - \frac{13}{100}\overline{e}$$

While the *LM* curve can be written as:

$$r = -\frac{1}{75}\left(\frac{M}{P}\right) + 0.006666\bar{6}Y$$

b) [5 MARKS] Assuming that $r_{for} = 0.12$, find the long-run equilibrium value of Y. Then, proceed to find the level of government spending G required to sustain this long-run equilibrium, *ceteris paribus*, and find equilibrium values of C, I, and NX. Finally, represent the long-run equilibrium graphically in the (r, Y) space.

We first sub in $r = r_{for} = 0.12$ into the *LM* curve, in the process also using $M = 600$ and $P = 1$, to find full-employment output:

$$\overline{Y} = 1218$$

Then, we sub $r = 0.12$, $\overline{e} = 1.8$ and $\bar{Y} = 1218$ into the *IS* curve to obtain:

$$G = 109.20$$

We thereafter can find:

$$C = 1061.06$$

$$I = 165$$

$$NX = -117.26$$

The usual graph follows.

c) [6 MARKS] Contractionary monetary policies in foreign economies have caused the foreign interest rate to increase above the domestic value, such that $r_{for} = 0.18 > r = 0.12$. Explain what implications this has for the domestic currency: is it now undervalued or overvalued, and why? The government does not want the fixed exchange rate or monetary policy to change in the short run. What fiscal policy must it implement in order to achieve this? Find short-run equilibrium output Y, and the implied policy response by thereafter finding G. Then, illustrate and explain its effect using the *IS-LM-FE* diagram.

As a result of $r_{for} > r$, there are now arbitrage opportunities abroad, which would cause under a flexible exchange rate system the exchange rate to fall. However, $\overline{e} = 1.8$ is fixed, meaning that the fixed rate exceeds its fundamental value. The government must increase the interest rate to world levels if it wants to prevent a devaluation of the currency, or a contraction of the money supply to buoy the fundamental value of the currency up to its pegged rate. This means that the *IS* curve must shift upwards, hence implying an *increase* in G. The exact value of G is found by first substituting in the new short-run interest rate $r = 0.18$ into the LM curve, which yields short-run output Y for a constant M and P. This Y is then substituted into the *IS* curve along with $r = 0.18$, with $\overline{e}$ being constant, to find G. This yields:

$$Y = 1227$$

$$G = 142.80$$

d) [6 MARKS] Suppose that instead of intervening right away, the government in c) decides to dither about the choice of policy. This leads speculators to believe that the domestic currency's fixed exchange rate no longer matches its fundamental value.

(i) Based on your answer in c), describe what options the country's central bank has in the event of a speculative run on its currency, and their effects.

(ii) In the end, it turns out that the central bank has no other choice but to change e to match the fundamental value of the exchange rate, and achieve interest parity again. If G, M, and P remain constant at their values specified or found in parts a) and b), what would be the new $\overline{e}$ and the short-run equilibrium Y?

(i) The three options are: devalue the currency (costly as it might hinder the investors' confidence, and trigger a further speculative run, which can only be remediated by a more important devaluation, etc.), decrease money supply (i.e., use foreign reserves to buy Canadian dollars on the currency market; yet this is not sustainable, especially if this speculative run is important or if the currency is strongly overvalued, as foreign reserves are limited), or impose capital controls (tends to be rather badly interpreted by markets, and reviled by many, yet can be effective: cf. Hong Kong, 1990s).

(ii) We want to return to the short-run equilibrium found in c), only now by changing the fixed exchange rate rather than by modifying government expenditures. Since $r = 0.18$, and holding M and P constant, we find once again that $Y = 1227$. Holding G constant at its value found in b) (i.e. $G = 109.20$), this means that we must have an devaluation of the currency, such that the IS curve shifts up (outwards). We can thence find $\overline{e}$ by subbing in Y, r and G into the equation for the IS curve, which yields:

$$1227 = 1310.40 - 65\overline{e}$$

$$\iff \overline{e} = 1.283076923$$