

Name:  
Student No.:

**SPP/Econ 556**  
**Macroeconomics**  
**Final Exam - Answers**

April 26 & 29, 1999

Answer all questions, on these sheets in the spaces or blanks provided. In questions where it is appropriate, **show your work**, if you want partial credit for an incorrect answer. Point values of the questions are shown; there are a total of 85 points possible.

1. (10 points) In the long-run, closed-economy model of Mankiw's Chapter 3, compare the effects on GDP,  $Y$ , and on the real interest rate,  $r$ , of the policies listed below. That is, consider the model whose components are:

$$\text{Production Function: } Y = F(\bar{K}, \bar{L}) \quad (1)$$

$$\text{Wage: } W = MPL = F_L(\bar{K}, \bar{L}) \quad (2)$$

$$\text{Consumption: } C = C(Y - \bar{T}) \quad (3)$$

$$\text{Investment: } I = I(r) \quad (4)$$

$$\text{Goods Market Equilibrium: } Y = C + I + \bar{G} \quad (5)$$

with endogenous variables  $Y$ ,  $W$ ,  $C$ ,  $I$ , and  $r$  and exogenous variables  $\bar{K}$ ,  $\bar{L}$ ,  $\bar{T}$ ,  $\bar{G}$  and implicit shift parameters for each of the functions. (Assume, as is explicit above but may seem odd below, that the capital stock,  $\bar{K}$ , is *not*, in the time horizon of the model, changed by investment,  $I$ .)

Now determine the effects on  $Y$  and  $r$  of the following four policies:

- Policy 1: Government increases its purchases,  $\bar{G}$ , by \$1 m, spending this on environmental cleanup. That is  $\Delta\bar{G} = 1$  and  $\Delta\bar{K} = \Delta\bar{L} = \Delta\bar{T} = 0$ .
- Policy 2: Government decreases taxes,  $\bar{T}$ , by \$1 m. That is  $\Delta\bar{T} = -1$  and  $\Delta\bar{K} = \Delta\bar{L} = \Delta\bar{G} = 0$ .
- Policy 3: Government offers a tax credit to firms, causing them to increase their level of investment,  $I$ , by \$1 m for any given level of the interest rate. (Remember, this investment does *not* change the level of the capital stock,  $\bar{K}$ .) That is  $\Delta\bar{I} = 1$  and  $\Delta\bar{K} = \Delta\bar{L} = \Delta\bar{T} = \Delta\bar{G} = 0$ .
- Policy 4: Government spends \$1 m directly increasing the capital stock,  $\bar{K}$ , but having done so, continues with its levels of purchases and taxes unchanged. That is  $\Delta\bar{K} = 1$  and  $\Delta\bar{L} = \Delta\bar{T} = \Delta\bar{G} = 0$ .

In the space below, use the above model and your knowledge of the functions involved to rank these policies, relative both to each other and to zero, in terms of their effects on  $Y$  and  $r$ . Record your answers either as strings of inequalities and equalities (e.g.,  $\Delta x_3 > \Delta x_1 = \Delta x_2 = 0 > \Delta x_4$ ), or by filling in the tables at the bottom of the page with the signs  $>$ ,  $<$ , or  $=$ . If you don't fill in the tables, we will do it for you, based on your strings of inequalities and equalities. If you do fill in the tables, we will grade that, not the strings. You will get one-half point for each cell of the table that is filled in correctly (by you or by us). You need not show your work on this one, and your credit will not be affected by it if you do.

**Ans:** Policies 1, 2, and 3 leave  $K$  and  $L$  unchanged, and therefore (from (1)) do not change  $Y$ . Policy 4 increases the capital stock, thus increasing  $Y$ . So

$$\Delta Y_4 > 0 = \Delta Y_3 = \Delta Y_2 = \Delta Y_1.$$

As for the interest rate, that depends on the amount by which investment,  $I$ , must be changed in order to clear the goods market in (5). For policy 1, since  $Y$  and therefore  $C$  do not change,  $I$  must fall by the same amount that  $G$  increases, therefore requiring some particular increase in  $r$ ,  $\Delta r_1 > 0$ . For policy 3, the investment function shifts up by  $\Delta \bar{I} = 1$  which is the same amount as the increase in government purchases in policy 1. Here, since  $Y$ ,  $C$ , and  $G$  are all unchanged, the interest rate must rise to bring  $I$  also back down to its old level, and this requires the same change in  $r$  needed for policy 1. Thus  $\Delta r_3 = \Delta r_1 > 0$ . For policy 2, the tax cut increases  $C$  by the MPC times the tax cut, and thus by less than the increases in  $G$  and  $\bar{I}$  in policies 1 and 3. So investment must fall, but by less, and therefore  $0 < \Delta r_2 < \Delta r_1$ . Finally, for policy 4,  $Y$  increases without any change in  $G$ . The increase in  $Y$  increases  $C$  but by a smaller amount (the MPC), leaving a gap that must be filled, this time, by an increase in investment. So this time the interest rate falls. Combining all this:

$$\Delta r_1 = \Delta r_3 > \Delta r_2 > 0 > \Delta r_4$$

$? Y_1 = ? Y_2$	$? Y_1 = ? Y_3$	$? Y_1 < ? Y_4$	$? Y_1 = 0$
	$? Y_2 = ? Y_3$	$? Y_2 < ? Y_4$	$? Y_2 = 0$
		$? Y_3 < ? Y_4$	$? Y_3 = 0$
			$? Y_4 > 0$

$? r_1 > ? r_2$	$? r_1 = ? r_3$	$? r_1 > ? r_4$	$? r_1 > 0$
	$? r_2 < ? r_3$	$? r_2 > ? r_4$	$? r_2 > 0$
		$? r_3 > ? r_4$	$? r_3 > 0$
			$? r_4 < 0$

2. (10 points) Below are shown Solow-style diagrams for analyzing the growth of three economies, A, B, and C. All share the same production function,  $f(k)$ , the same 10% depreciation rate for capital, and the same initial condition: the capital-labor ratio  $k_0$ . They differ, however, in their savings propensities,  $s_i$ , and their population growth rates,  $n_i$ . Country A has a 50% savings rate and a 4% population growth rate. Country B has the same population growth rate as A, but a lower savings rate, 0.3. Country C has the same savings rate as A, but a zero population growth rate. Identify the following:

a. Which country(ies) has the highest steady state capital labor ratio?

C (see  $k^*$ )

b. Which country(ies) has the highest level of per capita consumption in steady state?

C (see  $\left(\frac{C}{L}\right)^*$ )

c. Which country(ies) has the highest growth rate of total (not per capita) income in steady state?

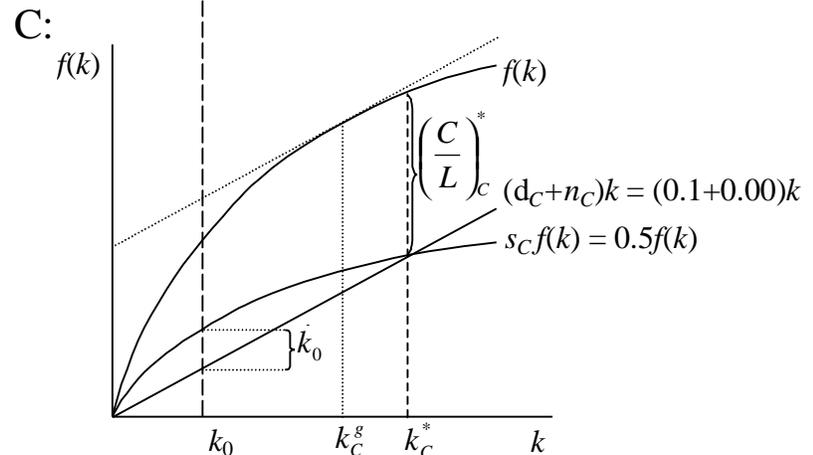
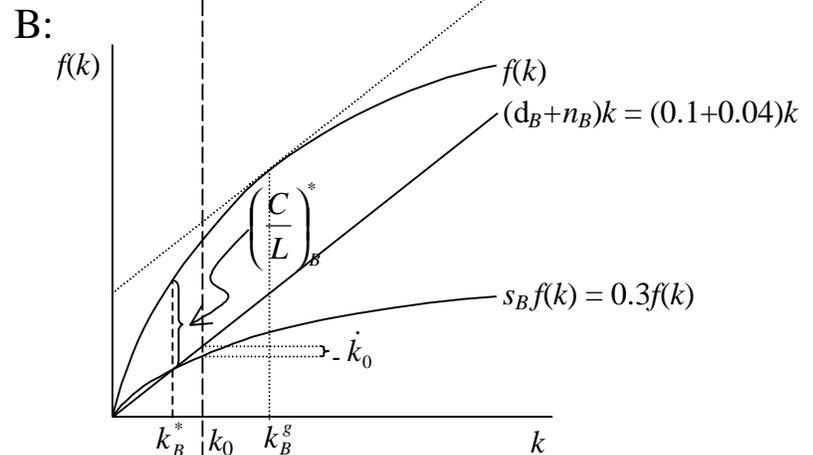
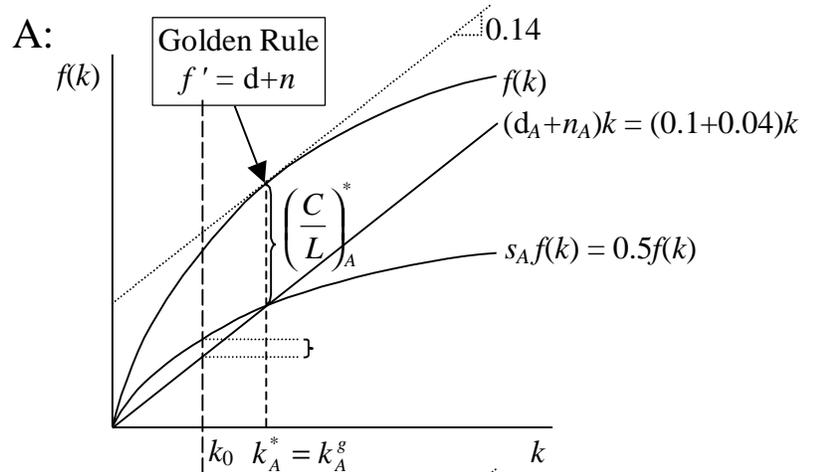
A and B (=  $n = 4\%$ )

d. Which country(ies) has the highest growth rate of the capital-labor ratio,  $k$ , initially?

C (see  $\dot{k}$ )

e. Which country(ies), if any, could increase its steady-state per capita consumption by saving less?

C  
 (see golden rule  $k^g$ )



3. (10 points) Mankiw's Open-Economy Long-Run Model is

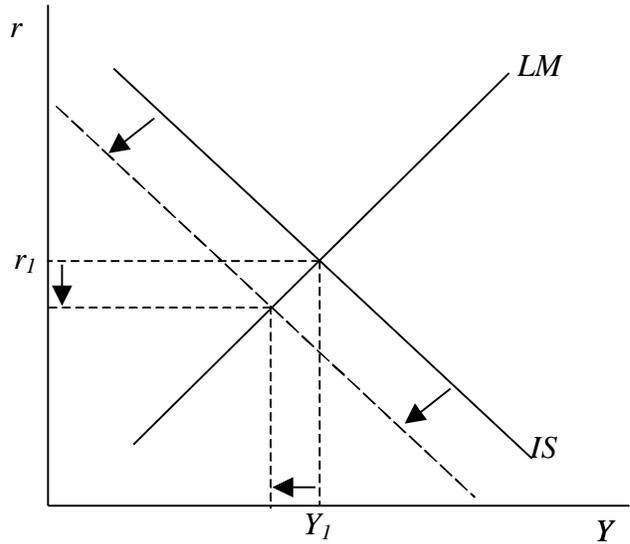
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|----------------------------|---|
| $Y = F(\bar{K}, \bar{L})$  | (1) Production Function, fixed factor endowments                        |
| $C = C(Y - \bar{T})$       | (2) Consumption Function, fixed taxes,<br>$0 < C \in MPC < 1$           |
| $I = I(r)$                 | (3) Investment Function, $I \leq 0$                                     |
| $Y = C + I + \bar{G} + NX$ | (4) Supply and demand for goods   |
| $r = r^*$                  | (5) Real interest rate pegged to world capital market                   |
| $NX = NX(\epsilon)$        | (6) Net exports depend negatively on real exchange<br>rate, $NX \leq 0$ |

Suppose that the consumption function now shifts down, due perhaps to a worsening of consumer confidence. That is, for every level of disposable income, consumers want to consume less. Work out *and explain* the direction of the effect of this change on each of the following variables of the model:

- $Y$ : No change. Output continues to be determined by the available quantities of factors of production,  $K$  and  $L$ , which are exogenous in this model and not changed by a shift in the consumption function.
- $C$ : Falls. Since  $Y$  and  $T$  have not changed, the downward shift in the consumption function is enough to assure that consumption itself is reduced.
- $I$ : No change.  $I$  depends on the interest rate, which hasn't changed – see below.
- $r$ : No change. The domestic interest rate is equal to the world interest rate, which has not changed.
- $NX$ : Rises. From (4),  $NX = Y - C - I - G$ , and on the right-hand-side, only  $C$  has changed, falling as noted above. Therefore  $NX$  must rise, to absorb the output no longer purchased by consumers.
- $e$ : Depreciates (falls). To get net exports to rise, as needed to clear the goods market, the domestic currency falls in value.

4. (15 points) In each case below, you are given the IS-LM diagram with an initial equilibrium. Show how one or both of the curves change for the following exogenous changes in the model. Then, from that and the rest of the model, determine the qualitative changes (+,-,0,?) in the indicated variables. Give reasons for your results, where asked.

a. An increase in taxes. (S below refers to national savings, while PS refers to private savings.)



Y           -

r           -

C           -

Why? Because with higher T and lower Y, disposable income has surely fallen, reducing C.

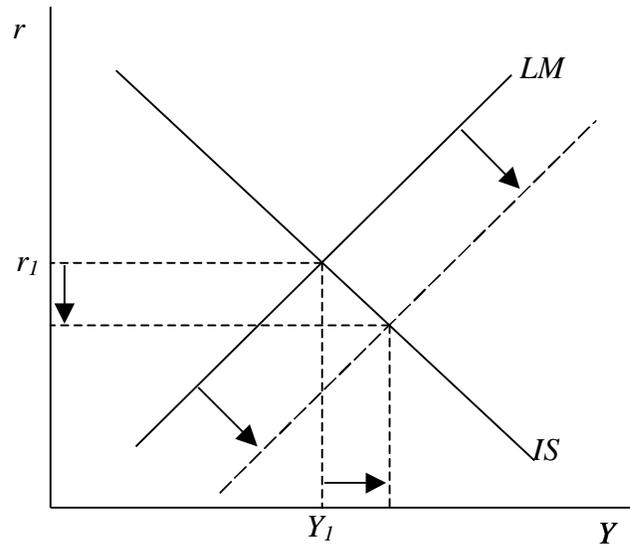
S           +

Why? S=I and I has risen due to the drop in r.

PS           -

Why? Private saving depends on disposable income, just like C, and has therefore also fallen.

b. A fall in the price level.



Y           +

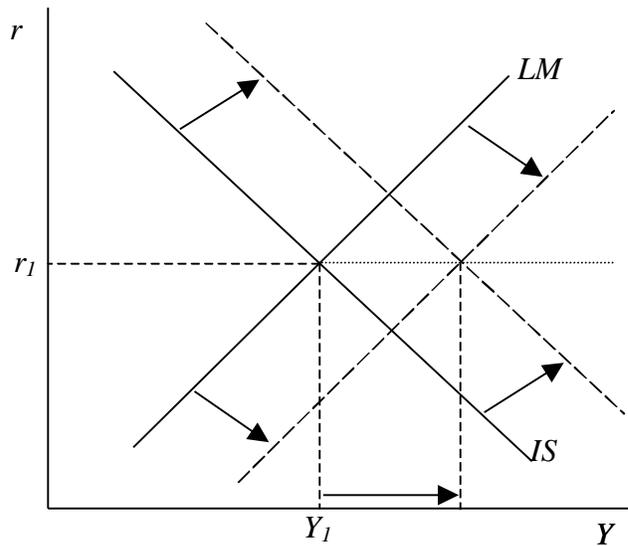
r           -

I           + Why? Because the interest rate falls.

C           + Why? Because income (and with fixed taxes, disposable income) increases

L           + Why? Because  $\Delta Y > 0$  and  $\Delta r < 0$  both raise  $L$ . Or because  $L = M/P$ ,  $M$  is constant, and  $P$  falls.

- c. An increase in government purchases *together with* an increase in the money supply, the two calibrated so that together they prevent any change in the interest rate. (S below refers to *national savings*.)



Y           +

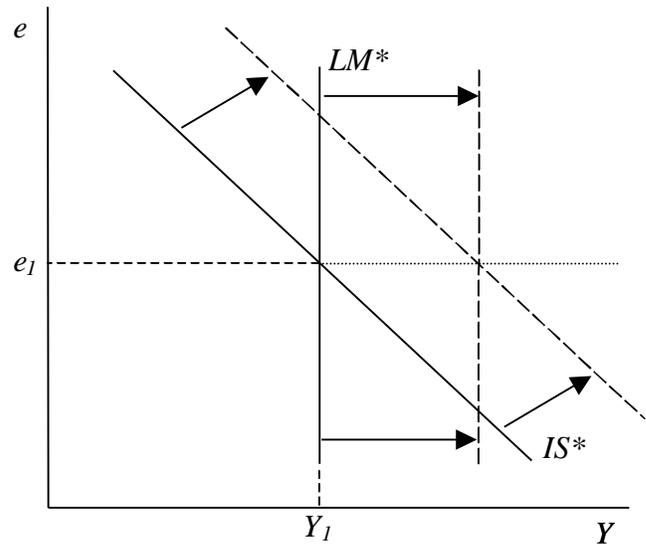
r           0

C           + Why? Because with increased Y and unchanged T, disposable income has surely risen, raising C.

S           0 Why? S=I and I is unchanged because r has been held fixed.

L           + Why? Because ?  $Y > 0$  with ?  $r = 0$  raises L. Or because  $L = M/P$ , P is constant, and ?  $M > 0$ .

5. (10 points) Using the Mundell-Fleming model of a small open economy with a pegged exchange rate, and starting from the equilibrium shown at the right, determine the effects of an upward shift in the investment function ( $\Delta \bar{I} > 0$ , meaning an increase in investment for each level of the interest rate). First show in the diagram how the curves shift, then answer and explain in words below how the indicated economic variables respond, and why.



- a. The exchange rate. (Explain the mechanism here.)

Does not change, because of course it is pegged. In this case, the increase in investment puts upward pressure on the interest rate, attracting a capital inflow that would otherwise cause the currency to appreciate. The central bank prevents this by selling domestic currency and thus raising the money supply enough to keep the interest rate at the world level.

- b. National Savings

Increases. This can be seen either from the fact that  $S=I$  and investment increases, which we know because the investment function has shifted without any change in  $r$ . It can also be seen from its components: private savings has increased due to the rise in  $Y$  (without any change in  $T$ ), while government savings is fixed by exogenous  $G$  and  $T$ .

- c. Central bank reserves

These increase, as the central bank intervenes to keep the currency from appreciating, it must buy foreign currencies, adding them to its reserves, and sell its own.

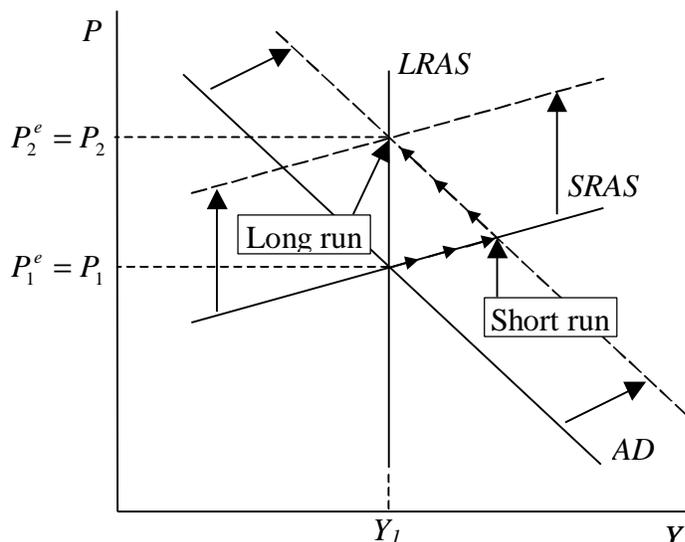
- d. The money supply

This increases too, which is why the  $LM^*$  curve is shifting to the right. It increases because the central bank is buying foreign currency, paying for it with domestic currency that then goes into circulation.

6. (10 points) Using first the aggregate supply and demand framework, and then the expectations-augmented Phillips Curve, show the effects of an initially unexpected, once-and-for-all increase in
- The level of the money supply (using AD-AS), and
  - The rate of growth of the money supply (using PhC).

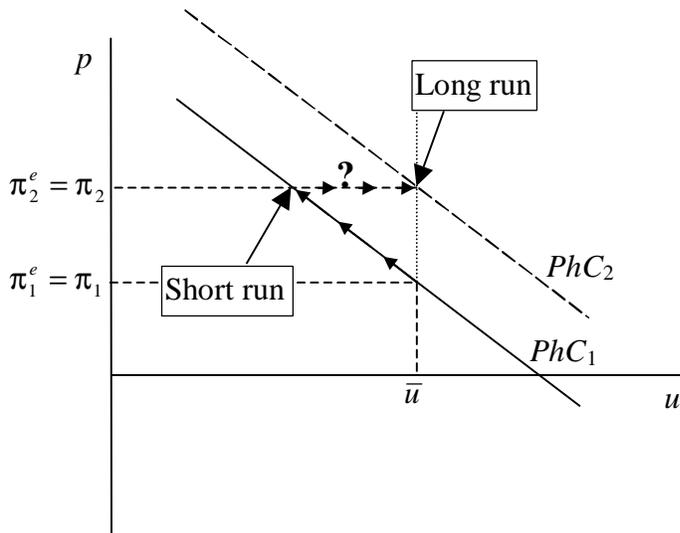
In both cases, starting from the long-run equilibrium shown in the diagrams, show where the economy goes in the diagram, in both the short run and in the long run, clearly labeling both the location of the economy and any shifts of curves. In addition, in the spaces beneath the diagrams write a short paragraph describing what happens and why. Be sure to explain the role of expectations in the adjustment process in both cases.

- a. An increase in the level of the money supply:



The increase in the level of the money supply shifts the AD curve to the right, causing an increase in income and the price level in the short run. This raises the actual price level above its expected level, causing over time expectations to be revised upwards. As the expected price level rises, the SRAS curve shifts up, and continues to do so until the equilibrium has moved up and to the left along AD to the long-run equilibrium shown at the initial level of income and a higher price.

b. An increase in the rate of growth of the money supply:



Since we start here with a positive rate of inflation  $p_1$ , the money supply was evidently already growing at a positive rate. Since this was a long run equilibrium (and since unemployment was at its natural rate,  $\bar{u}$ ) expected inflation must be equal to actual inflation at the start,  $p^e = p_1$ . The increase in the rate of monetary growth initially increases  $M$  faster than  $P$ , increasing the real money supply, expanding aggregate demand and therefore  $Y$  as in part (a), and reducing unemployment. The new short-run equilibrium is at lower  $u$ , and higher inflation  $p$  along the short-run Phillips Curve,  $PhC_1$ , as shown. Now the actual inflation is higher than expected, however, and the expectation of the *rate* of inflation is revised upward. This shifts the Phillips Curve upward as well, causing prices to rise faster and ultimately reducing  $M/P$ . The adjustment process can get complicated (the one shown is just a simple example), but in the long run we must return to the rate of inflation appropriate to the new higher rate of growth of the money supply, shown as  $p_2$ . And since this rate of inflation must also be expected in the long run, we return also to the natural rate of unemployment,  $\bar{u}$ . The short-run Phillips Curve settles at the position shown, corresponding to  $p^e = p_2$  at  $\bar{u}$ .

7. (20 points) TRUE-FALSE-WHY: For each of the following statements, say whether it is true or false, and write a single sentence or phrase indicating why.

- a. Gross domestic product does not include the value of the housing provided by homes that families own themselves.

False. The government imputes a value to these services and includes it in consumption.

- b. The Consumer Price Index is thought to overstate the rate of inflation.

True. This is what the Boskin Commission found, and was due to such things as the failure of the CPI to take account of quality improvements, new goods, and substitution away from higher-priced goods.

- c. An Efficiency Wage refers to the wage that is paid in a competitive labor market, equal to the value of the marginal product of labor.

False. Efficiency wage theory says that some firms will pay a higher wage than this for any of several reasons, such as to elicit greater effort or less shirking from their work force by giving them more to lose if they are fired.

- d. According to the quantity theory of money, the rate of inflation must equal the rate of growth of the nominal money supply.

False. That follows from  $M \times V = P \times Y$  only if  $V$  and  $Y$  are both constant. In a growing economy,  $Y$  is not constant, and it is not part of the quantity theory that it would be constant.

- e. In combination, the IS-LM model together with the AS-AD model imply that while a monetary expansion will raise the price level, a fiscal expansion will reduce it in the short run.

False. Both increase  $Y$  and the IS-LM model, which means they shift the AD curve to the right as well, raising the price level.

- f. According to the Mundell-Fleming Model, monetary policy is more effective under a floating exchange rate than under a pegged exchange rate.

True. Under a floating exchange rate, a monetary expansion causes the currency to depreciate, stimulating aggregate demand, but under a pegged rate it forces the central bank to intervene in the exchange market in a way that reduces the money supply back to where it started.

- g. In Mankiw's "sticky-price model," the slope ( $dP/dY$ ) of the short-run aggregate supply curve depends positively on the amount by which some firms increase their prices in response to an increase in the economy's output.

True. His solution for the SRAS curve in this model is  $P = P^e + [(1-s)a/s](Y - \bar{Y})$ , where  $a$  is the amount by which the non-sticky-price firms increase their prices in response to an increase in  $Y$ .

- h. Lags in the effects of macroeconomic policies provide an argument for active policy rather than passive policy, since if you wait passively until problems have arisen, it will be too late to solve them.

False. Passive policy means to *not try* to solve the problems, because lags mean that attempts to do so, by affecting the economy at the wrong times, will make fluctuations even worse,

- i. In March of this year, wages finally began to rise faster than they had in previous months, signaling that the Phillips Curve is continuing to operate.

False. As reported in the last assigned, article in the Wall Street Journal, wage increases actually slowed down in March.

- j. Time inconsistency would be illustrated, if I didn't have a GSI for this course, by my commitment to grade this exam. I promised to grade it, so that you would study for it and work hard in taking it, but after you are done these motives no longer apply and I would rather not grade it. You knew this, and hence you didn't believe me and didn't take the exam seriously.

True. Time inconsistency refers to the difficulty of committing to an action that you will not want to do. In macro, the standard example is the commitment by a government to restrain monetary growth to fight inflation, a commitment that they'll be tempted to abrogate for short-run unemployment (or even reelection) purposes. If you understood this concept well enough (and forgot about Dan), you may not have gotten this far on the exam.