

## 180.101 Principles of Macroeconomics, Fall 2011

### *Final Exam* : Practice Problems

1. Granting your oddly specific wish, a genie magically creates a suitcase containing four hundred pennies, four quarters, five thousand \$100 bills, and a check from the Fed for ten thousand dollars payable to “cash”.

- (a) How much currency did the genie give you? And how much M1?

The pennies, quarters, and bills are all currency. These total to a value of \$500,005. The check payable to cash is also included in M1 with the currency, so the total value of M1 in the suitcase is \$510,005.

- (b) If you also have a debit card with a \$2000 limit, a \$1 million savings deposit, and a credit card with a \$200 credit limit, what is your total quantity of M2?

The debit card draws on a checking account, so it is part of both M1 and M2. The savings deposit is also part of M2. Credit cards are not part of the money supply. Thus the total quantity of M2 is \$1,512,005.

- (c) If you owe \$2005 to Johns Hopkins University for tuition, what is your net worth?

Net worth is defined as assets less liabilities. Assuming no other assets or liabilities than the ones listed here, your net worth is \$1,510,000, because the \$2005 debt is a liability.

- (d) In a fit of generosity, you give the suitcase to your best friend, who deposits all of its contents at Bank A. If the required reserve ratio is 5%, explain how the money supply will be affected (in total). What is the deposit multiplier in this question?

When the money in the suitcase is deposited at Bank A, Bank A's demand deposits go up by \$510,005, its reserves go up by the same amount (some in the form of cash in the vault, and some in the form of a larger reserve deposit account at the Fed from the check), but its required reserves only go up by 5% of this amount. The remaining 95% is excess reserves and able to be loaned out to households or firms, so that the bank will earn interest. When the bank loans out the excess reserves, this money will eventually make its way to another bank, which will also be able to loan out 95% of that quantity. This repeated process is called deposit expansion. The deposit multiplier here is  $\frac{1}{0.05} = 20$ , so the total change in deposits will be \$10,200,100. The initial deposit took money out of circulation, so this subtracts from the money supply. The total change in the money supply is thus \$9,690,095.

2. Explain the following concepts.

- (a) Explain what it means for a bank to be “reserve deficient”. What must a bank do if it finds itself in this situation?

A bank is reserve deficient when its total reserves (cash on hand plus its reserve deposit account at the Fed) are less than its required reserves. Required reserves are equal to the required reserve ratio times the bank's total demand deposits. If a bank is reserve deficient, it is in violation of the law and must rectify the situation very quickly. It does so by acquiring reserves however it can. This might involve selling assets or taking out a loan from a bank that has excess reserves (borrowing federal funds).

- (b) Explain what economists mean when they refer to banks acquiring “earning assets”. Give some examples of earning assets, and explain why banks would want them.

Earning assets are any assets that earn interest over time. For example, a loan to a business is an earning asset because the firm will pay back to the bank more than the principal on the loan. A government bond is also an earning asset, as the market price of the bond will be less than the payout at maturity. Other earning assets include loans to households, loans of federal funds to other banks, or corporate stocks or bonds. Banks purchase or acquire earning assets using their excess reserves. They do so because holding on to reserves in the form of cash or reserve deposits yields basically no interest (likely a negative real interest rate); like other businesses, banks exist to earn profit, and thus they acquire earning assets to raise revenue.

3. Suppose the budget is defined as given in class:  $Bud = G + TR + InP - TX$ .

- (a) Identify which elements of the above equation are government spending and which are government receipts.

Government purchases of goods and services  $G$ , transfer payments  $TR$ , and interest payments  $InP$  are all examples of government spending (money out the door). Total tax revenues  $TX$  are government receipts (money in the door).

- (b) Explain the concept of the national debt. Describe very briefly the basic relationship between the budget and the national debt.

The national debt  $ND$  is the sum of the value of all government bonds owned by the public (i.e. not owned by the central government). This is money that the government owes to someone other than itself. The national debt accumulates year on year through the budget deficit  $Bud$ . When  $Bud > 0$ , the government must issue bonds in order to cover the shortfall of receipts relative to spending, and thus the national debt goes up by this magnitude. When  $Bud < 0$ , the government can use its surplus of receipts relative to spending to buy back some of the bonds in circulation, so that the national debt goes down by this magnitude; it holds those bonds and then vacuously pays itself the face value of the bonds when they mature. Mathematically, the relationship between the national debt and the budget is  $\Delta ND = Bud$ , the change in the national debt equals the budget deficit.

- (c) Suppose  $TX = \bar{T}X + tY$ . To what extent can the government control the budget?

While the government chooses its level of purchases, the amount of transfer payments it makes, the marginal tax rate, and the quantity of autonomous taxes (collectively, the fiscal policy instruments  $\bar{G}, \bar{TR}, \bar{T}X, t$ ), it cannot control the level of real income  $Y$ . GDP could fluctuate unexpectedly due to shocks to aggregate supply or demand. Thus income tax revenue  $tY$  cannot be exactly controlled by the government, only controlled on average or in expectation. Moreover, interest payments are equal to the interest rate on government bonds times the current national debt:  $InP = i_{GB}ND$ . If the interest rate on government bonds changed unexpectedly (perhaps due to increased fears of sovereign default), then interest payments are another uncontrollable portion of the budget.

4. For this question, assume that the required reserve ratio is 20%, and the economy is operating under ordinary supply conditions. Suppose the Federal Reserve decides to sell \$80 billion of U.S. Treasury Bills on the open market.

(a) How would the money supply change as a result of this action? Explain carefully, using any diagrams as appropriate.

Suppose customers of M&T Bank purchase all \$80B of the Bills that the Fed is selling. They would do so by writing checks to the Fed, drawn on their account at M&T. The Fed would receive these checks, deduct \$80B from the reserve account of M&T, and pass them along to M&T so that they could appropriately deduct from the demand deposit accounts of its customers. In this way, the Fed has reduced its liabilities (in the form of M&T's reserve account) and reduced its assets (in the form of Treasury Bills) by \$80B, while M&T has also reduced its assets (in the form of reserves at the Fed) and its liabilities (in the form of demand deposits) by \$80B. Because M&T's required reserves have fallen by \$16B (20% of the decrease in demand deposits) but its total reserves have fallen by \$80B, it is now reserve deficient by \$64B (because it held no excess reserves by assumption). The bank must then acquire \$64B of reserves in some way, either by selling assets or loans or calling in short term debt. Either way, the funds to pay for this must have been withdrawn from another bank which was fully loaned up, making that bank reserve deficient as well. This process of deposit destruction will contract the money supply by a total of  $\$80B \cdot \frac{1}{0.2} = \$400B$  using a geometric series argument.

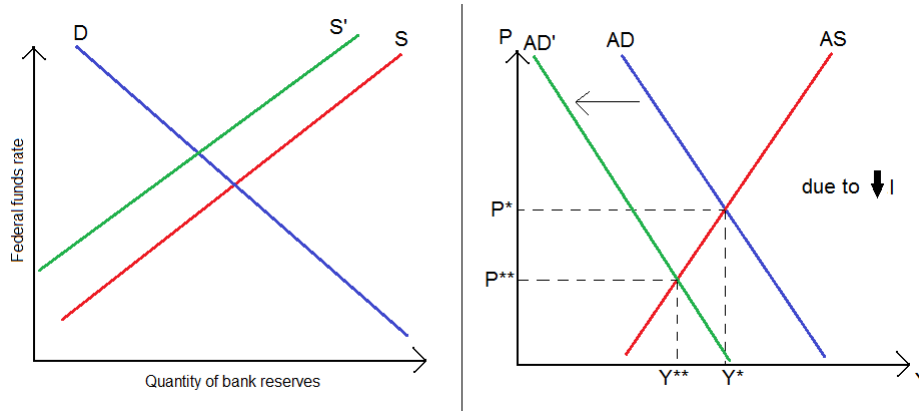
step 1			
Federal Reserve		M&T Bank	
GB	-80B	M&T ResAcct	-80B
		R	-80B
		RR	-16B
		ER	-64B
		DD	-80B
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step 2			
M&T Bank		Bank of America	
R	-16B	DD	-80B
RR	-16B	R	-64B
ER	+0	RR	-12.8B
ST	-64B	ER	-51.2B

(b) Why would the Fed choose to take such a course of action? What is the goal of this policy? Carefully explain how this action will achieve the result desired by the Fed, using any diagrams as appropriate.

The Fed would conduct an open market sale if it wanted the economy to reach a higher target federal funds rate and thus higher overall interest rate in the economy. Its ultimate policy goal with such a maneuver is to decrease inflation in the short run by curbing the price level (or the growth of the price level).

With fewer reserves in the financial system as a whole, banks will be less willing to lend funds to each other in order to meet reserve requirements, no matter the federal funds rate. This is a leftward shift in the supply curve for bank reserves. If the federal funds

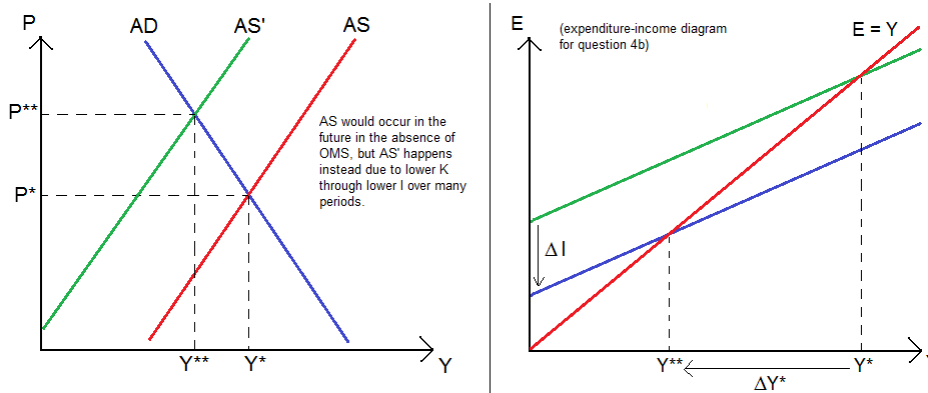
rate stayed at its original rate, more banks would want to borrow reserves than were willing to lend them; some banks would bid up the interest rate by offering the lending banks a higher return on the short term loan. The lending banks would love the higher return, and thus  $i_{FF}$  increases. Graphically, we see this on the supply-demand diagram for the market for bank reserves: the new intersection has lower reserves and a higher federal funds rate. In turn, the increase in  $i_{FF}$  increases the overall interest rate  $i$  in the economy because an opportunity cost of a risky loan (e.g. a mortgage) is not being able to loan at the (relatively) risk free federal funds rate. When  $i$  increases, this represents an additional cost to borrowing; some capital projects that would have been profitable at a lower interest rate (the cost to fund the project) are no longer profitable with the higher interest rate, and thus investment  $I$  decreases. This is a downward shift in the expenditure schedule, and thus a lower demand side equilibrium GDP at every price level. In the  $P - Y$  plane, this is represented by an inward shift in the aggregate demand curve. GDP will decrease because of the lower demand, but more saliently so will the price level because firms will bid down prices to win customers' business. The goal of the Fed in undertaking the OMS was to reduce inflation, and they have done so by lowering the price level.



- (c) What are the benefits and costs of this action, in both the short run and the long run? Explain carefully, using any diagrams as appropriate.

In the short run, the obvious benefit is that the Fed has succeeded in lowering the price level and inflation, its primary goal of this action. It likely engaged in contractionary monetary policy because inflation was higher than desired, causing myriad undesirable effects (unpredictable changes in relative prices, loss of value of stored wealth, etc). However, it came at the short run cost of lower GDP. This can be seen graphically in the AS-AD diagram from part (c).

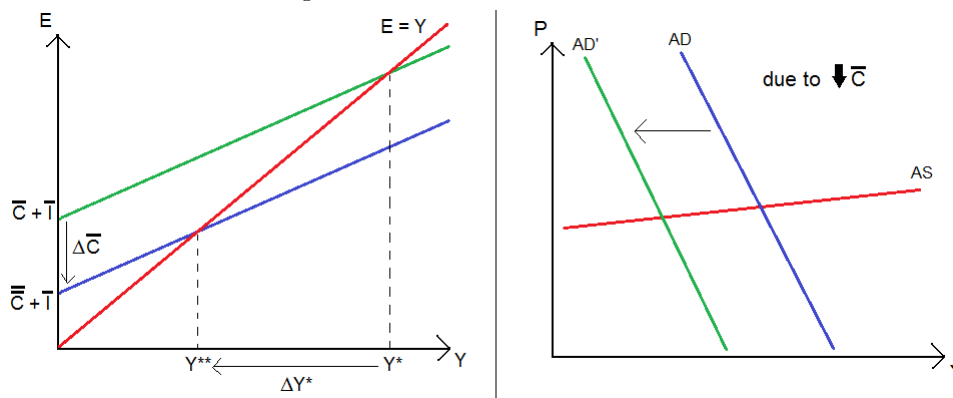
In the long run, the rate of capital formation has been reduced (through lower investment repeated over many periods). This means that the outward movement of the aggregate supply curve has been slowed down because capital  $K$  is not accumulating as rapidly as it would have had investment been higher. In this way, several years down the line the AS curve will not have shifted out as far as it would have without the open market sale of Treasury Bills. This means that the economy will experience lower GDP and higher prices than it otherwise would have.



5. Consider a country operating under slack conditions with a government that happens to be running a balanced budget. Citizens of this country have recently become distraught because a close ally is entering a recession, undermining confidence in their own economy.

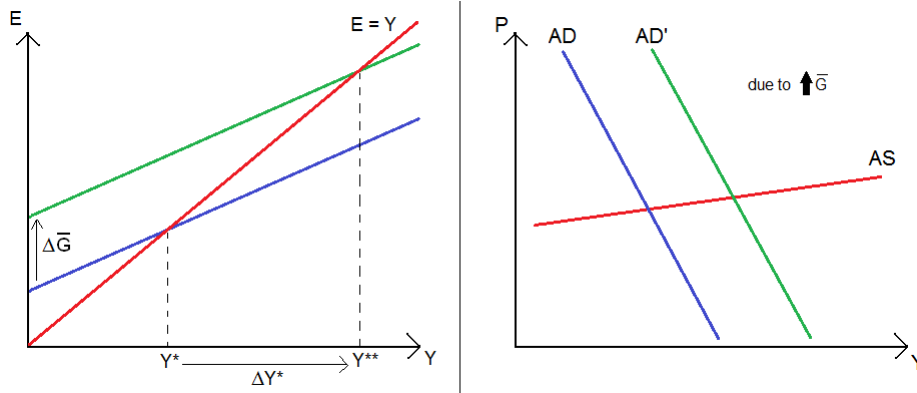
- (a) How would this event be captured in our model? Carefully describe in economic terms how this change would affect GDP and the price level, using (and explaining) any relevant graphs.

If citizens' mood significantly sours, this would be expressed as a decrease in autonomous consumption,  $\bar{C}$ . This would be expressed as a downward shift in the expenditure schedule: at each level of income or output, the agents of the economy want to purchase less goods and services. This sets off the multiplier process (negatively), in which the money that is not spent never becomes income to someone else, and thus they must decrease their consumption based on this; this process repeats itself indefinitely. In the end, equilibrium demand-side GDP is lower at every price level— an inward shift in the aggregate demand curve. Under slack conditions, the aggregate supply curve is very shallow, so nearly all of this shift in demand will result in a decrease in GDP in the country, with a very small (or no) drop in the price level. Firms are unable to cut prices to induce customers to purchase more.



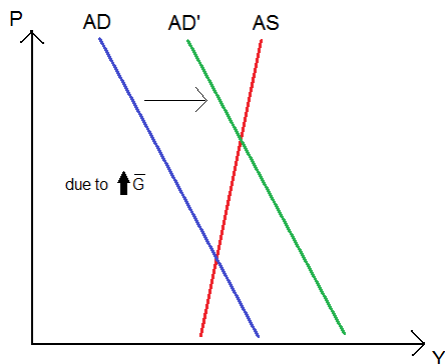
- (b) Suppose the government wants to fight these changes by increasing government purchases of goods and services. Is this a wise course of action? Carefully explain in economic terms how this will or will not achieve the government's goal, using any relevant graphs.

This is a wise course of action. If the government increases its purchases of goods and services,  $\bar{G}$ , this will shift the expenditure schedule upwards: the agents of the economy now want to buy more at every level of income or output. This additional expenditure contributes to GDP, and puts more income into peoples' pockets, allowing them to consume more based on their marginal propensity to consume. This chain reaction of consumption spending becoming income with which to spend more on consumption continues indefinitely. The result is higher demand side equilibrium GDP at every price level— an outward shift in the aggregate demand curve. Because we are in slack conditions, firms will be unable to appreciably raise prices in response to this; factors of production are readily available to use, so any attempt to raise price will be met by a large increase in production by a rival firm while undercutting the raised price, stealing all of the price-raising firm's business. Thus the shift in demand will boost GDP without increasing prices by much. That is, the country will achieve a higher income (a good thing) without paying much of an inflationary cost.



- (c) How would your answer to part (b) change if the economy were instead operating under relatively tight conditions (for this part only)?

If the economy were instead operating under tight conditions— a steep aggregate supply curve due to the unavailability of unemployed workers and unused capital— then this would not be a wise course of action. In that case, the shift in demand in part (a) would have resulted largely in a drop in the price level without much of a decrease in GDP. Likewise, boosting demand through  $\bar{G}$  to shift the ADC back outward will largely only increase the price level (inflation) without much of a benefit in terms of output or income. Firms are unable to produce much more output under tight conditions because there are very few workers and machines leftover to do any more work; firms can respond to changes in demand by increasing price rather than output, knowing that their competitors will do so as well. Thus this plan is a poor choice under tight conditions.



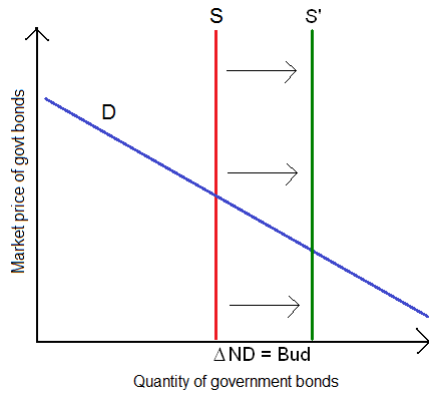
- (d) How will the national debt be affected by this policy action? Will the magnitude of the change in the national debt be greater than, less than, or equal to the change in government spending? Explain carefully.

It is likely that the national debt will increase because of the increase in government spending. The budget was balanced before these events occurred ( $Bud = 0$ ), so that spending and tax revenue were equal. When the economy entered a recession due to the decrease in autonomous spending, income tax revenue  $tY$  decreased, increasing the budget deficit ( $Bud = G - T$ ) through lower tax revenue. Likewise, the budget deficit also increased with the increase in government spending because  $\bar{G}$  is a component of  $G$ . The budget deficit represents the change in the national debt, and thus the national debt will increase because  $Bud$  is now positive. However, the increase in government spending also increased GDP, and thus increased tax revenue  $tY$ . This reduces the budget deficit, and so the change in the national debt will be smaller than the increase in government spending.

- (e) How will private investment spending be affected by these events? Explain carefully in economic terms, using any relevant graphs.

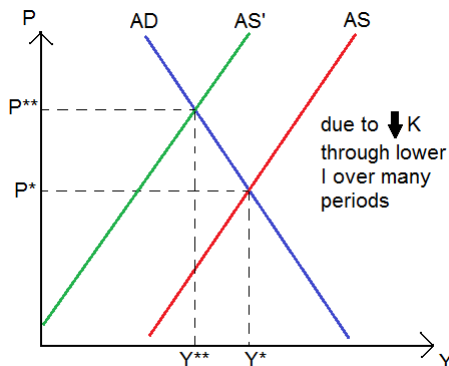
When more debt is issued, the treasury must lower the price of government bonds to induce investors to purchase them. This is an outward shift in the (vertical) supply curve for government bonds. The new equilibrium point will have more bonds (unsurprisingly, as more were issued) sold at a lower price. Because of the inverse relationship between a bond's price and the implicit interest rate on that bond, the interest rate on government bonds ( $i_{GB}$ ) increases (investors pay less for the bond now, while getting the same payoff of the face value of the bond, earning a higher 'profit' and thus a higher interest rate). This increase in the interest rate on government bonds sets off a chain reaction across other interest rates, boosting the aggregate interest rate  $i$ . The interest rate is a cost of borrowing for private firms, and this rate increase will cause some capital projects that were profitable at the original lower interest rate to not be profitable at the higher interest rate. Firms will not want to undertake capital projects that are not profitable, and thus there will be fewer purchases of capital: a decrease in investment  $I$ . This process is referred to as 'crowding out': an increase in government spending increases interest rates and thus decreases private investment. The crowding out will likely be partial: the decrease in  $I$  is less than the increase in  $\bar{G}$  for a net positive effect.

It is also possible that there will also be some ‘crowding in’ of private investment (or autonomous consumption). Because firms see that the government is taking action to fix the recession, they will be more confident about the future and more willing to expand future capacity through investment purchases.



- (f) Carefully explain the long run consequences of this policy. What fiscal policy actions can the government take to minimize these long run consequences?

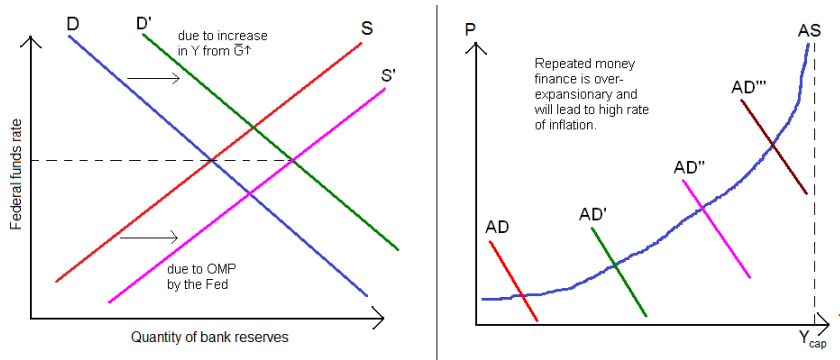
In the long run, the decrease in the level of investment will accrue as a lower level of capital over time. Investment represents the flow of new capital; figuratively speaking, when the spigot is tightened to reduce the flow, there will be less liquid in the bucket in the future. With a lower stock of capital in the future, the aggregate supply curve will not have shifted out as far as it otherwise would have in the absence of the increase in the national debt: with fewer machines, firms will be unable to produce as much output at any given price level. This will result in lower GDP and a higher price level than otherwise would have occurred; these are both bad things, as the country will not be as rich and it will experience more inflation during the intervening years. Very simply, the government can try to minimize these consequences by paying down the national debt, thus increasing bond prices and decreasing interest rates. It is wise to pay down the debt (by running a budget surplus,  $Bud < 0$ ) during a boom, when incomes are high (so it is not painful to pay higher taxes and government spending is not needed to boost demand) and the government is concerned with inflation and might pursue a contractionary fiscal policy anyway.



- (g) What are the differences between money finance and debt finance? What additional costs and benefits are associated with using money finance rather than debt finance?

Explain carefully, using any relevant graphs.

Money finance is best described as debt finance plus an open market purchase of government bonds by the central bank. While debt finance tends to increase interest rates through lower bond prices, money finance is designed to counteract this effect by boosting demand for bonds (because the central bank is purchasing them). Thus the additional benefit of money finance is that private investment spending will not be crowded out through higher interest rates. The cost of this policy is that it is extra-expansionary: an expansionary fiscal policy with an expansionary monetary policy on top. It thus runs the risk of pushing the aggregate demand curve too far outwards too fast, leading to rapid rates of inflation as the economy operates under tighter and tighter conditions. This inflationary cost can also be understood from the view that the government is effectively ‘monetizing the debt’: the central bank does not have an unlimited supply of cash to keep purchasing government bonds, and so the treasury is printing money for the central bank to use. Cutting out the middle man, the government accomplishes the same result by simply printing new currency to pay off its debts; this greatly expands the money supply, diluting the value of the currency and causing massive inflation.



6. Consider a country with a total population of 68.2 million, of whom 34.8 million hold a job while 2.7 million do not have a job but are seeking work.
- (a) Calculate the labor force participation rate, the unemployment rate, and the employment rate for this country, briefly explaining your answers.

The labor force participation rate is the percentage of the population that is either employed or unemployed (has a job or is looking for one). In this case, the LFPR is  $\frac{34.8M+2.7M}{68.2M} \approx 55\%$ . The unemployment rate is the percentage of the labor force that is unemployed, or  $\frac{2.7M}{37.5M} = 7.2\%$ . Likewise, the employment rate is the percentage of the labor force that is employed, or one minus the unemployment rate: 92.8%.

- (b) Economists estimate that the natural rate of unemployment in this country is 5.4%. Explain what is meant by this, and calculate the cyclical unemployment rate. Is this economy likely in a boom or a recession?

The natural rate of unemployment is the percentage of the labor force that is either frictionally or structurally unemployed. These individuals are either between jobs and likely to find a new one soon (frictional) or there is some mismatch between the worker’s skills and those demanded by the local labor market (structural). This rate is believed

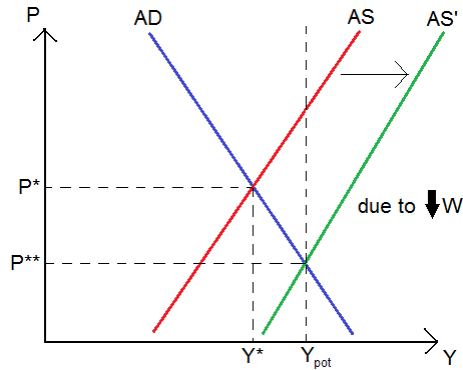
to be fairly constant over long periods of time, and the economy tends to gravitate back toward the natural rate of unemployment (or full employment) when it has moved away. When the economy is operating at full employment, we say that it is producing at 'potential GDP'. The cyclical unemployment rate is the difference between the actual employment rate and the natural rate: the residual percentage that is not explained by market frictions or structural deficiencies and is likely due to the business cycle. In this case, the cyclical unemployment rate is at  $7.2 - 5.4 = 1.8\%$ . This is a significant number compared to the natural rate of employment: fully one third more individuals are unemployed than would be under full employment levels. Thus the economy is likely in a recession, when real GDP falls.

- (c) Suppose that as time passes, none of the 2.7 million unemployed individuals are able to find a job. Because of this, one half million of them give up looking for a job. How does the unemployment rate change because of this? Briefly comment on this phenomenon.

If 0.5M individuals stopped looking for work, our definition would capture this as those individuals leaving the labor force. So while no one has found new employment, the calculated unemployment rate will fall. Specifically, it will now be:  $\frac{2.2}{34.8+2.2} = 5.95\%$ . This is a drastic decline in the unemployment rate, creating the appearance that the economy is now operating near the natural rate of unemployment, even though the unemployment rate only decreased because economic conditions are so poor. This is a problem with the definition of the unemployment rate and a reason why some economists calculate the unemployment rate in a different manner that will not exhibit this counterintuitive behavior.

- (d) In the long run, what do you expect will happen to the unemployment rate? Carefully explain using economic terms (and any relevant graphs) how this will occur.

In the long run, the unemployment rate tends to gravitate back towards the natural rate of unemployment. In this situation, that means that we expect the unemployment rate to fall back down to 5.4% over time. This will occur because the slack labor market gives power to firms (or away from workers) so that wage increases are difficult to come by, or wages might even be cut. Workers must compete for scarce jobs and may be willing to make wage concessions to do so. The decrease in the wage rate makes firms more willing to hire workers, decreases production costs, and increases profit; thus firms have more motive to produce at any price level, shifting the aggregate supply curve outward. This will reduce the price level (deflation) and boost output. Meanwhile, the extra hired workers means the unemployment rate has declined, eventually reaching its natural level.



- (e) Suppose the government wanted to speed up the changes you described in part (d). What actions could they take to do so?

The government can attempt to speed up the move back toward the natural rate of unemployment by engaging in expansionary fiscal policy: increasing government purchases or transfer payments or cutting taxes. If the government attempts to boost aggregate demand through additional spending or tax cuts, then unemployment might be brought down as firms hire more workers to keep up with the increased demand for goods and services. The cost of this policy is that the economy will experience a higher rate of inflation (also due to the outward shift in the aggregate demand curve). Rather than waiting for wages to fall so that firms hire more workers, the government can instead motivate firms to hire.

7. Consider a country with a population of ten million people and a GDP of \$10 billion. The growth rate of the population and GDP are both 10% per year. Calculate income per capita and the growth rate of income per capita for this country.

Income per capita is simply the total GDP divided by the population. In this case, it is simply  $\frac{\$10B}{10M} = \$10,000$ . The growth rate of income per capita is zero. Intuitively, if GDP and the population are growing at the same rate, then in the future there will be proportionally more income and people, and thus the same amount of income to go around per person. More generally, the growth rate of income per capita is the growth rate of income minus the growth rate of the population.

8. Consider the historically poor and unstable country of Hooveria, which has experienced a low growth rate of real GDP per capita over the past sixty years. What specific policy recommendations would you make to help Hooveria increase its economic growth? Explain how these recommendations will help, and why they are better than other potential policy actions in this specific situation. (Note: there is no single “right” answer, but there are plenty of wrong ones.)

Any reasonable argument about which methods of stimulating growth are the most logical first steps for a country to take to pull itself out of poverty would suffice here. Stability and property rights should probably get a mention, as they are required for any real growth to occur (so that both foreign and domestic investors don’t have unreasonable levels of uncertainty about potential projects). Because the country is historically poor, it is also likely

uneducated; thus it can make large gains in worker productivity over time if it generates a more educated workforce. The first step toward this is likely to create a public education system, which might be completely lacking. Suggestions to stimulate growth that probably do not fit this situation would pertain to developing new technologies: when a country is very poor, it is better to adopt the already developed production techniques of other countries rather than try to develop one's own. Likewise, trying to build a proper system of intellectual property laws is not likely to help much.

Answers that focus on expansionary fiscal policy also aren't very good. Efforts to shift the aggregate demand curve are generally used in stabilization policy to manage short run fluctuations, while this question asks you about efforts to increase growth. Correct answers address policies that push out the aggregate supply curve over the long run. Government spending can play a role in this process, but purchases of 'public capital' and infrastructure (roads, bridges, railways, communication networks) must be specifically mentioned. These assist firms in producing goods and thus shift out the aggregate supply curve.