CHAPTER 2

Solutions to Problems in the Textbook:

Conceptual Problems:

1. Government transfer payments (TR) do not arise out of any production activity and are thus not counted in the value of GDP. If the government hired the people who currently receive transfer payments, then their wages would be counted as part of government purchases (G), which is counted in GDP. Therefore GDP would rise.

2.a. If the firm buys a car for an executive's use, the purchase counts as investment (I). But if the firm pays the executive a higher salary and she then buys a car, the purchase is counted as consumption (C).

2.b. The services that a homemaker provides are not counted in GDP (regardless of their value). However, if an individual officially hires his or her spouse to perform household duties at a certain wage rate, then the wages earned will be counted in GDP and GDP will increase.

2.c. If you buy a German car, consumption (C) will increase but net exports (NX = X - Q) will decrease. Overall GDP will increase by the value added at the foreign car dealership, since the import price is likely to be less than the sales price. If you buy an American car, consumption and thus GDP will increase. (Note: If the car you buy comes out of the car dealer's inventory, then the increase in C will be partially offset be a decline in I, and GDP will again only increase by the value added.)

3. GDP is the market value of all final goods and services currently produced within the country. (The U.S. GDP includes the value of the Hondas produced by a Japanese-owned assembly plant that is located in the U.S., but it does not include the value of Nike shoes that are produced by an American-owned shoe factory located in Malaysia.)

   GNP is the market value of all final goods and services currently produced using assets owned by domestic residents. (Here the value of the Hondas produced by a Japanese-owned Honda plant is not counted but the value of the Nikes by the American-owned shoe plant is.)

   Neither is necessarily a better measure of the output of a nation. The actual value of the GDP and GNP for the U.S. is fairly close.

4. The NDP (net domestic product) is defined as GDP minus depreciation. Depreciation measures the value of the capital that wears out during the

production process and has to be replaced. Therefore NDP comes closer to measuring the net amount of goods produced in this country. If this is what you want to measure, then NDP should be used.

5. Increases in real GDP do not necessarily mean increases in welfare. For example, if the population of a country increases by more than real GDP, then the population of the country is on average worse off. Also some increases in output come from welfare reducing events. For example, increased pollution may cause more lung cancer, and the treatment of the lung cancer will contribute to GDP. Similarly, an increase in crime may lead to overtime work for police officers, whose increased salary will increase GDP. But the welfare of the people in the country may not have increased in either case. On the other hand, GDP does not always accurately measure quality improvements in goods or services (faster computers or improved health care) that improve people's welfare.

6. The CPI (consumer price index) and the PPI (producer price index) are both measured by looking at a certain market basket. The CPI's basket contains mostly finished goods and services that consumers tend to buy regularly in their daily lives. The PPI's basket contains raw materials and semi-finished goods, that is, it measures costs to the producer of a product and its first user. The CPI is a concurrent economic indicator, whereas the PPI is a leading economic indicator.

7. The GDP-deflator is a price index that covers the average price increase of all final goods and services currently produced within an economy. It is defined as the ratio of current nominal GDP to current real GDP. Nominal GDP is measured in current dollars, while real GDP is measured in so-called base-year dollars. Even though early estimates of the GDP-deflator tend to be unreliable, the GDP-deflator can be a more useful price index than the CPI or PPI (both of which are fixed market baskets). This is true for two reasons: first it measures a much wider cross-section of goods and services; second, a fixed market basket cannot account for people substituting away from goods whose relative prices have changed, while the GDP-deflator, which includes all goods and services produced within the country, can.

8. If nominal GDP has suddenly doubled, it is most likely due to an increase in the average price level. Therefore, the first thing you would want to check is by

how much the GDP-deflator has changed, to calculate by how much real output (GDP) has changed. If nominal GDP and the GDP-deflator have both doubled, then real GDP should be the same.

9. Assume the loan you made yields you an annual nominal return of 7%. If the rate of inflation is 4%, then your rate of return in real terms is only 3%. If, on the other hand, if inflation rate is 10%, then you will actually get a negative real rate of return, that is, you will lose 3% of your purchasing power. One way to protect yourself against such a loss of purchasing power is to adjust the interest rate for inflation, that is, to index the loan. In other words, you can require that, in addition to the specified interest rate of the loan of, let's say, 3%, the borrower also has to pay an inflation premium equal to the percentage change in the CPI. In this case, a real rate of return of 3% would be guaranteed.

Technical Problems:

1. The text calculates the change in real GDP in 1992 prices in the following way:
   $[RGDP_{01} - RGDP_{92}]/RGDP_{92} = [3.50 - 1.50]/1.50 = 1.33 =$ **133%.**

To calculate the change in real GDP in 2001 prices, we first have to calculate the GDP of 1992 in 2001 prices. Thus we take the quantities consumed in 1992 and multiply them by the prices of 2001, as follows:

Beer	1 at $2.00 =	$2.00
Skittles	1 at $0.75 =	$0.75
Total		$2.75

The change in real GDP can now be calculated as
$[6.25 - 2.75]/2.75 = 1.27 =$ **127%.**
We can see that the growth rate of real GDP calculated this way is roughly the same as the growth rate calculated above.

2.a. The relationship between private domestic saving, investment, the budget deficit and net exports is shown by the following identity:

$$S - I \equiv (G + TR - TA) + NX.$$

Therefore, if we assume that transfer payments (TR) remain constant, then an increase in taxes (TA) has to be offset either by an increase in government purchases (G), a decrease in net exports (NX), or a decrease in the difference between saving (S) and investment (I).

2.b. From the equation $YD \equiv C + S$ it follows that an increase in disposable income (YD) will be reflected in an increase in consumption (C), saving (S), or both.

2.c. From the equation YD ≡ C + S it follows that when either consumption (C) or saving (S) increases, disposable income (YD) must increase as well.

3.a. Since depreciation $D = I_g - I_n = 800 - 200 = 600$ ==>
NDP = GDP - D = 6,000 - 600 = **5,400**
3.b. From GDP = C + I + G + NX ==> NX = GDP - C - I - G ==>
NX = 6,000 - 4,000 - 800 - 1,100 = **100.**
3.c. BS = TA - G - TR ==> (TA - TR) = BS + G ==> (TA - TR) = 30 + 1,100 = **1,130**
3.d. YD = Y - (TA - TR) = 5,400 - 1,130 = **4,270**
3.e. S = YD - C = 4,270 - 4,000 = **270**

4.a. S = YD - C = 5,100 - 3,800 = **1,300**
4.b. From S - I = (G + TR - TA) + NX ==> I = S - (G + TR - TA) - NX = 1,300 - 200 - (-100) = **1,200**.
4.c. From Y = C + I + G + NX ==> G = Y - C - I - NX ==>
G = 6,000 - 3,800 - 1,200 - (-100) = **1,100**.
Also: YD = Y - TA + TR ==> TA - TR = Y - YD = 6,000 - 5,100 ==> TA - TR = 900
From BS = TA - TR - G ==> G = (TA - TR) - BS = 900 - (-200) ==> G = 1,100

5. According to Equation (2) in the text, the value of total output (in billions of dollars) can be calculated as: Y = labor payments + capital payments + profits = \$6 + \$2 + \$0 = **\$8**

6.a. Since nominal GDP is defined as the market value of all final goods and services currently produced in this country, we can only measure the value of the final product (bread), and therefore we get \$2 million (since 1 million loaves are sold at \$2 each).
6.b. An alternative way of measuring total GDP would be to calculate all the value added at each step of production. The total value of the ingredients used by the bakeries can be calculated as:

1,200,000 pounds of flour	(\$1 per pound)	= 1,200,000
100,000 pounds of yeast	(\$1 per pound)	= 100,000
100,000 pounds of sugar	(\$1 per pound)	= 100,000
100,000 pounds of salt	(\$1 per pound)	= 100,000

= 1,500,000
Since $2,000,000 worth of bread is sold, the total value added at the bakeries is $500,000.

7. If the CPI increases from 2.1 to 2.3, the rate of inflation can be calculated in the following way:
rate of inflation = (2.3 - 2.1)/2.1 = 0.095 = **9.5%**
The CPI often overstates inflation, since it is calculated by using a fixed market basket of goods and services. But the fixed weights in the CPI's market basket cannot capture the tendency of consumers to substitute away from goods whose relative prices have increased. Therefore, the CPI will overstate the increase in consumers' expenditures.

8. The real interest rate (r) is defined as the nominal interest rate (i) minus the rate of inflation (π). Therefore the nominal interest rate is the real interest rate plus the rate of inflation, or
$i = r + \pi = 3\% + 4\% =$ **7%.**

CHAPTER 3
Solutions to the Problems in the Textbook

Conceptual Problems:

1. The production function provides a quantitative link between inputs and output. For example, the Cobb-Douglas production function mentioned in the text is of the form:
$Y = F(N,K) = AN^{1-\theta}K^{\theta}$,
where Y represents the level of output. $(1 - \theta)$ and θ are weights equal to the shares of labor (N) and capital (K) in production, while A is often used as a measure for the level of technology. It can be easily shown that labor and capital each contribute to economic growth by an amount that is equal to their individual growth rates multiplied by their respective share in income.

2. The Solow model predicts convergence, that is, countries with the same production function, savings rate, and population growth will eventually reach the same level of income per capita. In other words, a poor country may eventually catch up to a richer one by saving at the same rate and making technological innovations. However, if these countries have different savings rates, they will reach different levels of income per capita, even though their long-term growth rates will be the same.

3. A production function that omits the stock of natural resources cannot adequately predict the impact of a significant change in the existing stock of natural resources on the economic performance of a

country. For example, the discovery of new oil reserves or an entirely new resource would have a significant effect on the level of output that could not be predicted by such a production function.

4. Interpreting the Solow residual purely as technological progress would ignore, for example, the impact that human capital has on the level of output. In other words, this residual not only captures the effect of technological progress but also the effect of changes in human capital (H) on the growth rate of output. To eliminate this problem we can explicitly include human capital in the production function, such that
   $Y = F(K,N,H) = AN^aK^bH^c$ with $a + b + c = 1$.
   Then the growth rate of output can be calculated as
   $\Delta Y/Y = \Delta A/A + a(\Delta N/N) + b(\Delta K/K) + c(\Delta H/H)$.

5. The savings function $sy = sf(k)$ assumes that a constant fraction of output is saved. The investment requirement, that is, the $(n + d)k$-line, represents the amount of investment needed to maintain a constant capital-labor ratio (k). A steady-state equilibrium is reached when saving is equal to the investment requirement, that is, when $sy = (n + d)k$. At this point the capital-labor ratio $k = K/N$ is not changing, so capital (K), labor (N), and output (Y) all must be growing at the same rate, that is, the rate of population growth $n = (\Delta N/N)$.

6. In the long run, the rate of population growth $n = (\Delta N/N)$ determines the growth rate of the steady-state output per capita. In the short run, however, the savings rate, technological progress, and the rate of depreciation can all affect the growth rate.

7. Labor productivity is defined as Y/N, that is, the ratio of output (Y) to labor input (N). A surge in labor productivity therefore occurs if output grows at a faster rate than labor input. In the U.S. we have experienced such a surge in labor productivity since the mid-1990s due to the enormous growth in GDP. This surge can be explained from the introduction of new technologies and more efficient use of existing technologies. Many claim that the increased investment in and use of computer technology has stimulated economic growth. Furthermore, increased global competition has forced many firms to cut costs by reorganizing production and eliminating some jobs. Thus, with large increases in output and a slower rate of job creation we should expect labor productivity to increase. (One should also note that a higher-skilled labor force also can contribute to an increase in labor productivity, since the same number of workers can produce more output if workers are more highly skilled.)

Technical Problems:

1.a. According to Equation (2), the growth of output is equal to the growth in labor times the labor share plus the growth of capital times the capital share plus the rate of technical progress, that is,
   $\Delta Y/Y = (1 - \theta)(\Delta N/N) + \theta(\Delta K/K) + \Delta A/A$, where
   $1 - \theta$ is the share of labor (N) and θ is the share of capital (K). Thus if we assume that the rate of technological progress ($\Delta A/A$) is zero, then output grows at an annual rate of 3.6 percent, since
   $\Delta Y/Y = (0.6)(2\%) + (0.4)(6\%) + 0\% = 1.2\% + 2.4\% = + 3.6\%$,

1.b. The so-called "Rule of 70" suggests that the length of time it takes for output to double can be calculated by dividing 70 by the growth rate of output. Since $70/3.6 = 19.44$, it will take just under 20 years for output to double at an annual growth rate of 3.6%,

1.c. Now that $\Delta A/A = 2\%$, we can calculate economic growth as
   $\Delta Y/Y = (0.6)(2\%) + (0.4)(6\%) + 2\% = 1.2\% + 2.4\% + 2\% = + 5.6\%$.

Thus it will take 70/5.6 = 12.5 years for output to double at this new growth rate of 5.6%.

2.a. According to Equation (2), the growth of output is equal to the growth in labor times the labor share plus the growth of capital times the capital share plus the growth rate of total factor productivity (TFP), that is,

$\Delta Y/Y = (1 - \theta)(\Delta N/N) + \theta(\Delta K/K) + \Delta A/A$, where

$1 - \theta$ is the share of labor (N) and θ is the share of capital (K). In this example $\theta = 0.3$; therefore, if output grows at 3% and labor and capital grow at 1% each, then we can calculate the change in TFP in the following way

$3\% = (0.3)(1\%) + (0.7)(1\%) + \Delta A/A \Rightarrow \Delta A/A = 3\% - 1\% = 2\%$,

that is, the growth rate of total factor productivity is 2%.

2.b. If both labor and the capital stock are fixed and output grows at 3%, then all this growth has to be contributed to the growth in factor productivity, that is, $\Delta A/A = 3\%$.

3.a. If the capital stock grows by $\Delta K/K = 10\%$, the effect on output would be an additional growth rate of $\Delta Y/Y = (.3)(10\%) = 3\%$.

3.b. If labor grows by $\Delta N/N = 10\%$, the effect on output would be an additional growth rate of $\Delta Y/Y = (.7)(10\%) = 7\%$.

3.c. If output grows at $\Delta Y/Y = 7\%$ due to an increase in labor by $\Delta N/N = 10\%$, and this increase in labor is entirely due to population growth, then per capita income would decrease and people's welfare would decrease, since

$\Delta y/y = \Delta Y/Y - \Delta N/N = 7\% - 10\% = -3\%$.

3.d. If this increase in labor is due to an influx of women into the labor force, the overall population does not increase and income per capita would increase by $\Delta y/y = 7\%$. Therefore people's welfare would increase.

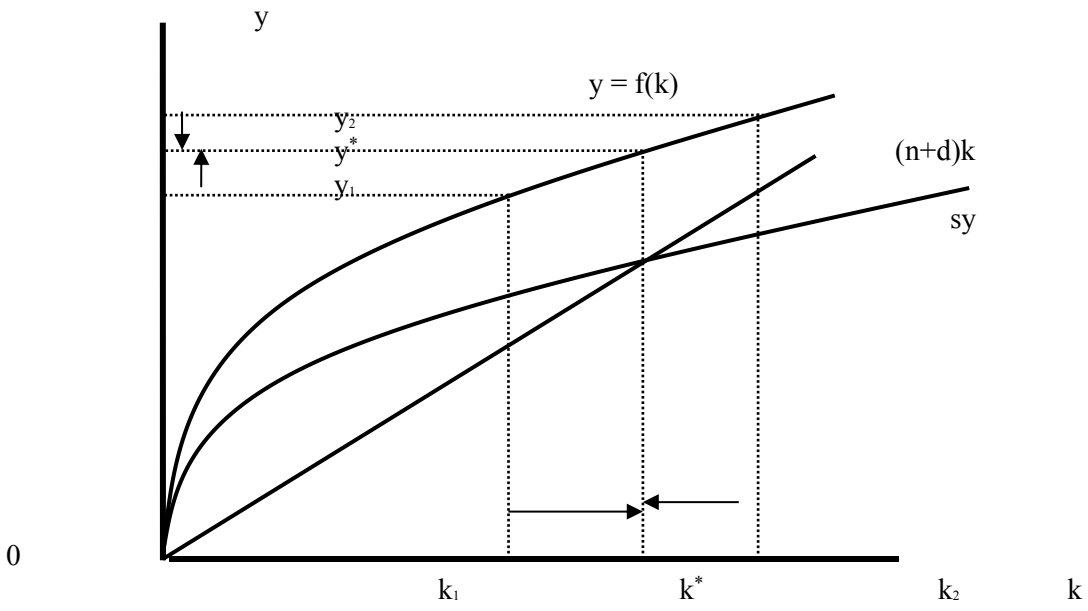
4. Figure 3-4 shows output per head as a function of the capital-labor ratio, that is, $y = f(k)$. The savings function is $sy = sf(k)$, and it intersects the straight $(n + d)k$-line, representing the investment requirement. At this intersection, the economy is in a steady-state equilibrium. Now let us assume that the economy is in a steady-state equilibrium before the earthquake hits, that is, the steady-state capital-labor ratio is currently k^*. Assume further, for simplicity, that the earthquake does not affect people's savings behavior.

If the earthquake destroys one quarter of the capital stock but less than one quarter of the labor force, then the capital-labor ratio falls from k^* to k_1 and per-capita output falls from y^* to y_1. Now saving is greater than the investment requirement, that is, $sy_1 > (d + n)k_1$, and the capital stock and the level of output per capita will grow until the steady state at k^* is reached again.

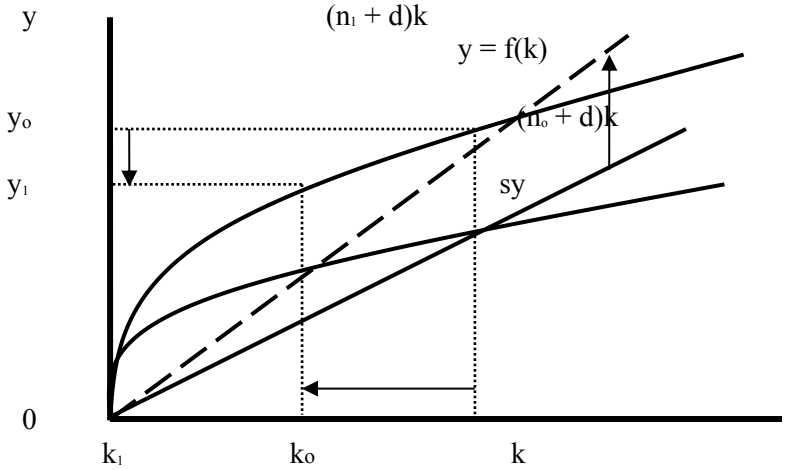
However, if the earthquake destroys one quarter of the capital stock but more than one quarter of the labor force, then the capital-labor ratio increases from k^* to k_2. Saving now will be less than the investment requirement and thus the capital-labor ratio and the level of output per capita will fall until the steady state at k^* is reached again.

If exactly one quarter of both the capital stock and the labor stock are destroyed, then the steady state is maintained, that is, the capital-labor ratio and the output per capita do not change.

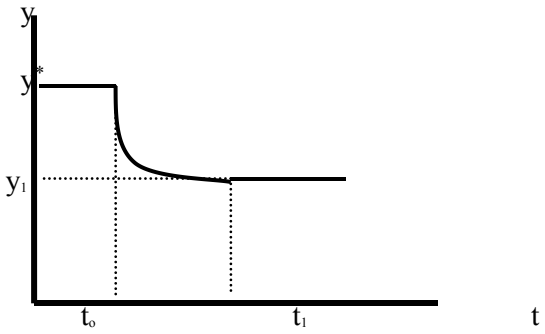
If the severity of the earthquake has an effect on peoples' savings behavior, then the savings function $sy = sf(k)$ will move either up or down, depending on whether the savings rate (s) increases (if people save more, so more can be invested in an effort to rebuild) or decreases (if people save less, since they decide that life is too short not to live it up).

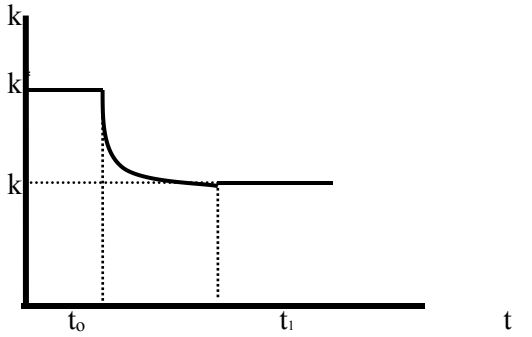


5.a. An increase in the population growth rate (n) affects the investment requirement, and the (n + d)k-line gets steeper. As the population grows, more saving must be used to equip new workers with the same amount of capital that the existing workers already have. Therefore output per capita (y) will decrease as will the new optimal capital-labor ratio, which is determined by the intersection of the sy-curve and the $(n_1 + d)k$-line. Since per-capita output will fall, we will have a negative growth rate in the short run. However, the steady-state growth rate of output will increase in the long run, since it will be determined by the new and higher rate of population growth.



5.b. Starting from an initial steady-state equilibrium at a level of per-capita output y^*, the increase in the population growth rate (n) will cause the capital-labor ratio to decline from k^* to k_1. Output per capita will also decline, a process that will continue at a diminishing rate until a new steady-state level is reached at y_1. The growth rate of output will gradually adjust to the new and higher level n_1.





6.a. Assume the production function is of the form

$Y = F(K, N, Z) = AK^aN^bZ^c$ ==>

$\Delta Y/Y = \Delta A/A + a(\Delta K/K) + b(\Delta N/N) + c(\Delta Z/Z)$, with $a + b + c = 1$.

Now assume that there is no technological progress, that is, $\Delta A/A = 0$, and that capital and labor grow at the same rate, that is, $\Delta K/K = \Delta N/N = n$. If we also assume that all natural resources available are fixed, such that $\Delta Z/Z = 0$, then the rate of output growth will be

$\Delta Y/Y = an + bn = (a + b)n$.

In other words, output will grow at a rate less than n since $a + b < 1$. Therefore output per worker will fall.

6.b. If there is technological progress, that is, $\Delta A/A > 0$, then output will grow faster than before, namely

$\Delta Y/Y = \Delta A/A + (a + b)n$.

If $\Delta A/A > c$, then output will grow at a rate larger than n, in which case output per worker will increase.

6.c. If the supply of natural resources is fixed, then output can only grow at a rate that is smaller than the rate of population growth and we should expect limits to growth as we run out of natural resources. However, if the rate of technological progress is sufficiently large, then output can grow at a rate faster than population, even if we have a fixed supply of natural resources.

7.a. If the production function is of the form

$Y = K^{1/2}(AN)^{1/2}$,

and A is normalized to 1, then we have

$Y = K^{1/2}N^{1/2}$.

In this case capital's and labor's shares of income are both 50%.

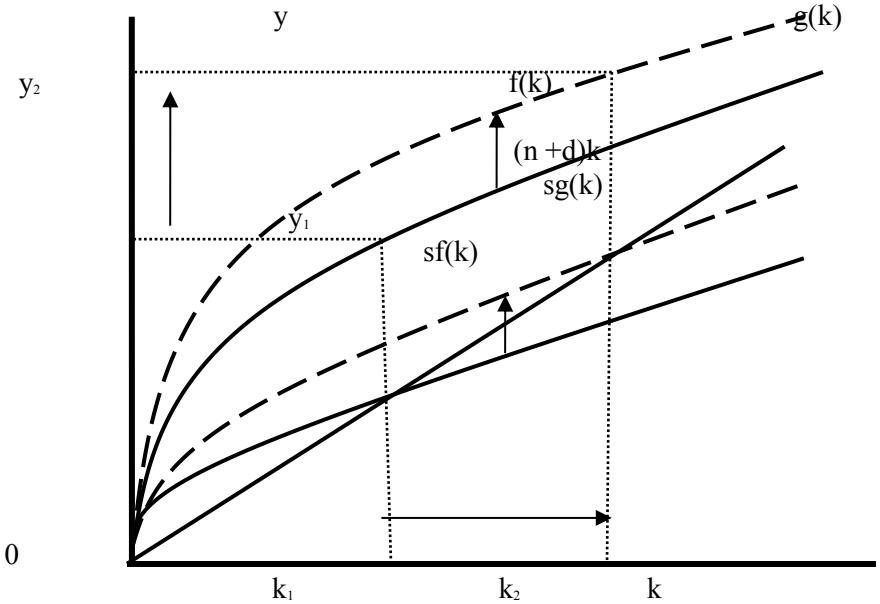
7.b. This is a Cobb-Douglas production function.

7.c. A steady-state equilibrium is reached when $sy = (n + d)k$.

From $Y = K^{1/2}N^{1/2}$ ==> $Y/N = K^{1/2}N^{-1/2}$ ==> $y = k^{1/2}$ ==>

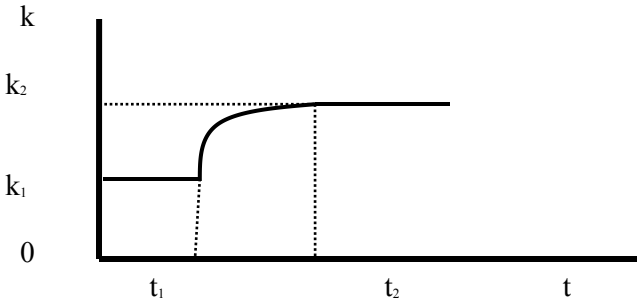
$sk^{1/2} = (n + d)k \quad ==> \quad k^{-1/2} = (n + d)/s = \quad (0.07 + 0.03)/(.2) = 1/2 \quad ==> \quad k^{1/2} = 2 = y ==> k = 4$.

8.a. If technological progress occurs, then the level of output per capita for any given capital-labor ratio increases. The function y = f(k) increases to y = g(k), and thus the savings function increases from sf(k) to sg(k).



8.b. Since g(k) > f(k), it follows that sg(k) > sf(k) for each level of k. Therefore the intersection of the sg(k)-curve with the (n + d)k-line is at a higher level of k. The new steady-state equilibrium will now be at a higher level of saving and output per capita, and at a higher capital-labor ratio.

8.c. After the technological progress occurs, the level of saving and investment will increase until a new and higher optimal capital-labor ratio is reached. The ratio of investment to capital will also increase in the transition period, since more has to be invested to reach the higher optimal capital-labor ratio.



9. The Cobb-Douglas production function is defined as

$Y = F(N,K) = AN^{1-\theta}K^{\theta}$.

The marginal product of labor can then be derived as

$MPN = (\Delta Y)/(\Delta N) = (1 - \theta)AN^{-\theta}K^{\theta} = (1 - \theta)AN^{1-\theta}K^{\theta}/N = = (1 - \theta)(Y/N)$

==> labor's share of income = $[MPN*(N)]/Y = (1 - \theta)(Y/N)*[(N)/(Y)] = (1 - \theta)$

CHAPTER 4
GROWTH AND POLICY
Solutions to the Problems in the Textbook

Conceptual Problems:

1. Endogenous or self-sustained growth supposedly can be achieved by policies that affect a nation's savings rate and therefore the proportion of GDP that goes towards investment. The neoclassical growth model of Chapter 3 predicted that long-term growth can only be achieved through technological progress and that changes in the savings rate have only transitory effects. The endogenous growth model, however, predicts that countries with a higher savings rate can achieve higher long-term growth and that a nation's government can affect the long-term growth rate by implementing policies that affect the savings rate.

2. A simple model with constant returns to scale to capital alone implies increasing returns to scale to all factors taken together, which could cause a single large firm to dominate the economy. However, such a model ignores the possibility that external returns to capital exist, in addition to the internal (private) returns. In other words, more investment not only leads to a higher and more efficient capital stock but also to new ideas and new ways of doing things, which can then be copied by others. Therefore, a single firm does not necessarily reap all of the benefits of increased output.

3. In the neoclassical growth model, an increase in the savings rate does not increase the long-term growth rate of output. However, because of the short-run adjustment process, there is some transitional gain that will lead to a higher level of output per capita. In the endogenous growth model, however, the savings rate does affect the long-term growth rate of output.

4.a. Chapter 4 suggests that the key to long-term economic growth is investment in human and physical capital with particular emphasis on research and development.

4.b. (i) Investment tax credits may potentially affect economic growth in the long run by achieving a higher rate of technological progress.

(ii) R&D subsidies and grants lead to technological advances that will have private and social returns. They are very effective in stimulating long-term economic growth.

(iii) According to the endogenous growth model, policies designed to increase the savings rate will increase the long-term growth rate of output. However, empirical evidence does not lend much support to that notion.

(iv) Increased funding for primary education has large private and social returns and is therefore an excellent means to stimulate long-term growth, even though it may take a long time until these policies have their full effect.

5. The notion of absolute convergence states that economies with the same savings rate and rate of population growth will reach the same steady-state equilibrium if they have access to the same technology. The notion of conditional convergence states that economies that have access to the same

technology and the same rate of population growth but different savings rates will reach steady-state equilibria at a different level of output but the same economic growth rate. There is empirical evidence to support the notion of conditional convergence across countries.

6. Endogenous growth theory assumes that the steady-state growth rate of output is affected by the rate at which the factors of production are accumulated. Therefore, an increase in the savings rate would increase the rate at which the capital stock is accumulated and this would increase the growth rate of output. While this notion may be important in explaining the growth rates of highly developed countries at the leading edge of technology, it cannot explain the differences in growth rates across poorer countries. For these countries, the notion of conditional convergence seems to hold.

7. Investing in physical capital will lead to a higher capital stock and to a higher level of output in the short run, but often to the detriment of long-term growth unless there are significant external returns to capital. Therefore, investing in human capital is a better strategy, since it has high returns and leads to an increase in long-term growth.

8.a. A country that is able to choose its rate of population growth through population control policies can shift the investment requirement down, thereby increasing the level of steady-state output. With a lower rate of population growth it is possible to achieve a higher level of income per capita with a lower level of investment spending. Therefore, implementing population control policies may be an effective way to escape the so-called poverty trap.

8.b. In an endogenous growth model, a lower population growth rate (n) will increase a nation's long-term growth rate ($\Delta y/y$). We can see this since, in the second optional section, the per-capita growth rate was derived, as follows:
$\Delta y/y = sa - (n + d)$.

9. The Asian Tigers (Hong Kong, Singapore, South Korea, and Taiwan) experienced a high rate of economic growth between 1966 and 1990 by concentrating on improving the education of the population and increasing the savings rate, as suggested by the endogenous growth model. However, increases in the labor forces of these countries suggested by the neoclassical growth model, were also at work.

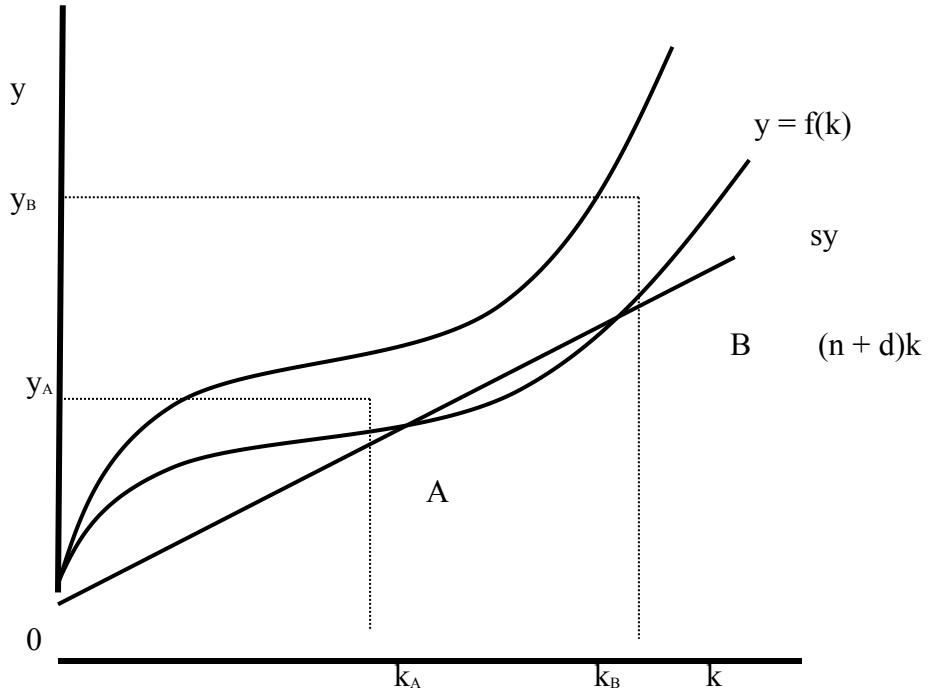
10. The decline in living standards experienced by Eastern European countries in transition from centrally planned economies to free market economies cannot easily be explained by neoclassical or endogenous growth theory. The decline in GDP in these countries was largely due to disorganized markets that lacked properly assigned property rights or liability rules and an insufficiently developed banking system. In addition, the need for large-scale replacement of outdated production technology caused further disruption.

11. In is unclear whether countries can actually experience indefinite increases in their growth potential. However, if technological advances occur continuously and if intelligent resource management is practiced, it is conceivable that economic growth will continue for a very, very long time.

Technical Problems:

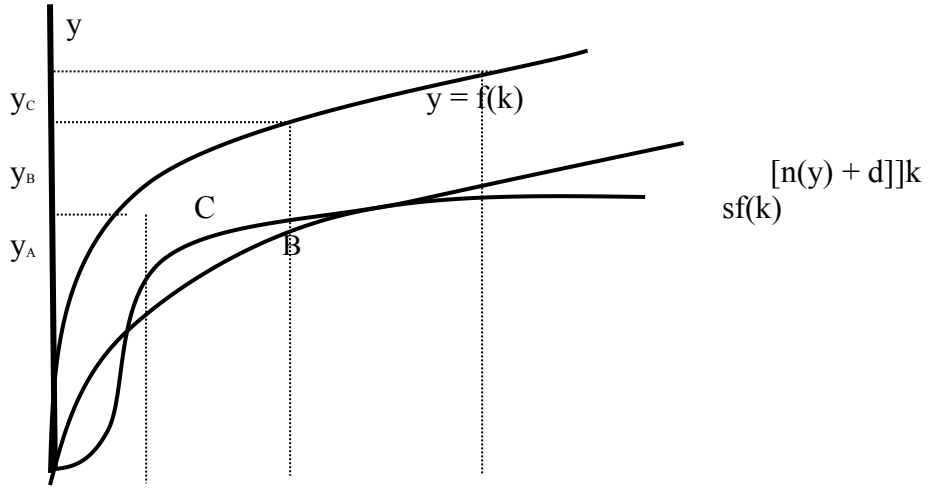
1.a. A production function that displays both a diminishing and a constant marginal product of capital can be displayed by drawing a curved line (as in an exogenous growth model), followed by a upward-sloping line (as in an endogenous growth model). Such a graph is depicted below.

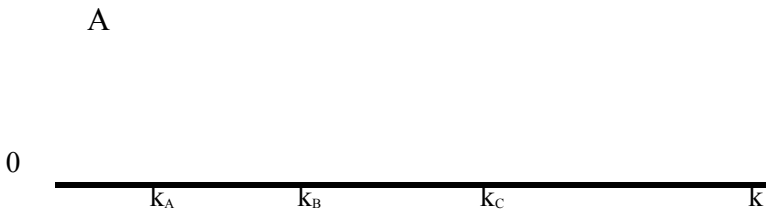
1.b. The first equilibrium (Point A in the graph below) is a stable low-income steady-state equilibrium. Any deviation from that point will cause the economy to eventually adjust again at the same steady-state income level (and capital-output ratio). The second equilibrium (Point B) is an unstable high-income steady-state equilibrium. Any deviation from that point will lead to either a lower income steady-state equilibrium (if the capital-labor ratio declines) or ongoing growth (if the capital-labor ratio increases).



1.c. A model like the one in this question can be used to explain how some countries can find themselves in a situation with no growth and low income while others have ongoing growth and a high level of income. In the first case, a country may have invested in physical capital, leading to some short-term growth at the expense of long-term growth, whereas in the second case, a country may have invested heavily in human capital, reaping significant social returns.

2.a. If population growth is endogenous, that is, if a country can influence the rate of population growth through government policies, then the investment requirement is no longer a straight line. Instead it is curved as depicted below.

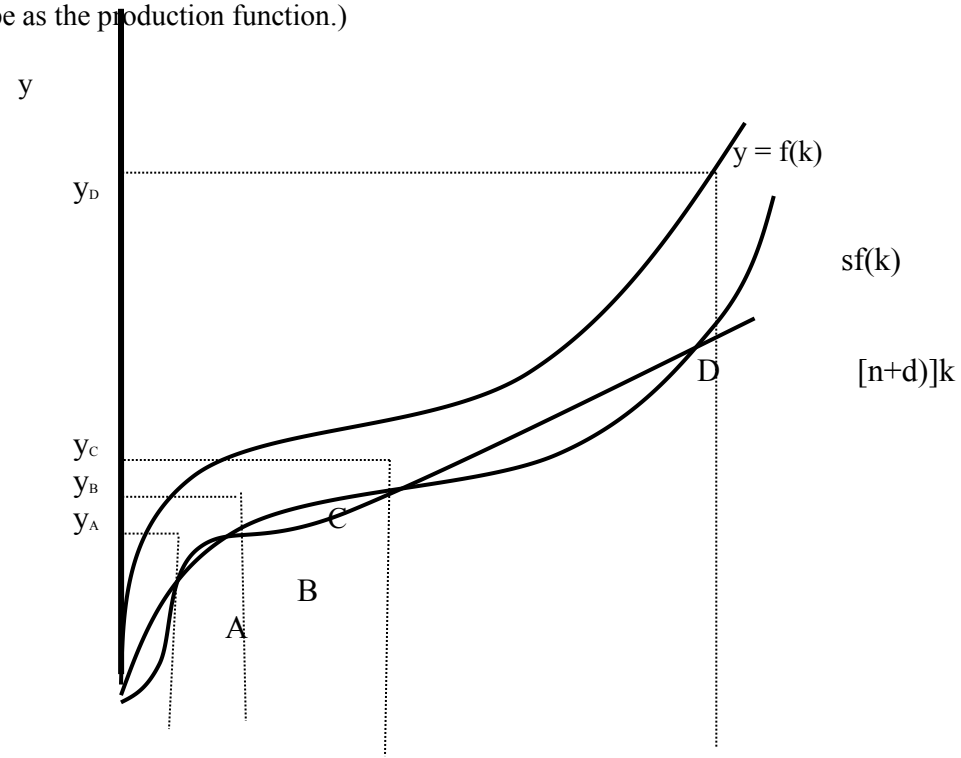


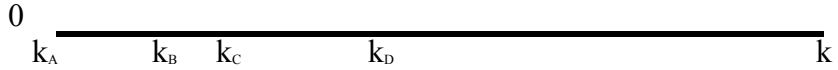


2.b. The first equilibrium (Point A) is a stable steady-state equilibrium. It is a situation of low income and high population growth, indicating that the country is in a poverty trap. The second equilibrium (Point B) is an unstable steady-state equilibrium. It is a situation of medium income and low population growth. The third equilibrium (Point C) is a stable steady-state equilibrium. It is a situation of high income and low population growth. None of these three equilibria have ongoing growth.

2.c. To escape the poverty trap (Point A), a country has several possibilities: First, it can somehow find the means to increase the capital-labor ratio above a level consistent with Point B (perhaps by borrowing funds or seeking direct foreign investment). Second, it can increase the savings rate such that the savings function no longer intersects the investment requirement curve at either Point A or Point B. Third, it can decrease the rate of population growth through specifically designed policies, such that the investment requirement shifts down and no longer intersects with the savings function at Point A or Point B.

3.a. If we incorporate endogenous population growth into a two-sector model in Problem 2, then we get a curved line for the investment requirement line and a production function with first a diminishing and then a constant marginal product of capital as depicted below. (Note that the savings function has the same shape as the production function.)





3.b. There should be four intersections of the savings function and the investment requirement. The first equilibrium (at Point A) is a stable low-income steady-state equilibrium. Any deviation from that point will cause the economy to eventually adjust again at the same steady-state income level (and capital-output ratio). The second equilibrium (at Point B) is an unstable low-income equilibrium. Any deviation from that point will lead to either a lower income steady-state equilibrium at Point A (if the capital-labor ratio declines) or a higher income steady-state equilibrium at Point C (if the capital-labor ratio increases). Point D is again an unstable equilibrium but at a high level of income. Any deviation from that point will lead to either a lower income steady-state equilibrium at Point C (if the capital-labor ratio declines) or ongoing growth (if the capital-labor ratio increases).

3.c. This model is more inclusive than either of the two models discussed previously, and therefore has greater explanatory power. But now the graphical analysis is far more complicated. It may not be worth the effort to introduce such complications.

4.a. The production function is of the form

$Y = K^{1/2}(AN)^{1/2} = K^{1/2}(4[K/N]N)^{1/2} = K^{1/2}(4K)^{1/2} = 2K$

4.b. Since $a = y/k = 2$, it follows that the growth rate of output is

$g = sa - (n + d) = (0.1)2 - (0.02 + 0.03) = 0.15 = 15\%$.

4.c. The term "a" in the equation above stands for the marginal product of capital. If we assume that the level of labor-augmenting technology (A) is proportional to the capital-labor ratio (k), we imply that the level of technology depends on the amount of capital per worker that we have, which may not be realistic.

4.d. In this model, we have a constant marginal product of capital, and therefore we have an endogenous growth model.

5.a. The production function is of the form

$Y = K^{1/2}N^{1/2} \Longrightarrow Y/N = (K/N)^{1/2} \Longrightarrow y = k^{1/2}$.

From $k = sy/(n + d) = sk^{1/2}/(n + d) \Longrightarrow k^{1/2} = s/(n + d)$

$\Longrightarrow y^* = s/(n + d) = (0.1)/(0.02 + 0.03) = 2$

$\Longrightarrow k^* = sy^*/(n + d) = (0.1)(2)/(0.02 + 0.03) = 4$

5.b. Steady-state consumption equals steady-state income minus steady-state investment, that is,

$c^* = f(k^*) - (n + d)k^*$.

The golden rule capital stock corresponds to the highest permanently sustainable level of consumption. Steady-state consumption is maximized when the marginal increase in capital produces just enough extra output to cover the increased investment requirement.

From $c = k^{1/2} - (n + d)k \Longrightarrow (\Delta c/\Delta k) = (1/2)k^{-1/2} - (n + d) = 0$

$\Longrightarrow k^{-1/2} = 2(n + d) = 2(.02 + .03) = .1 \Longrightarrow k^{1/2} = 10 \Longrightarrow k = 100$

Since $k^* = 4 < 100$, we have less capital at the steady state than the golden rule suggests.

5.c. From $k = sy/(n + d) = sk^{1/2}/(n + d) \Longrightarrow s = k^{1/2}(n + d) = 10(0.05) = .5$

5.d. If we have more capital than the golden rule suggests, then we are saving too much and we do not have the optimal amount of consumption.

Chapter 5
Solutions to the Problems in the Textbook

Conceptual Problems:

1. The aggregate supply curve shows the quantity of real total output that firms are willing to supply at each price level. The aggregate demand curve shows all combinations of real total output and the price level at which the goods and the money sectors are simultaneously in equilibrium.

Along the AD-curve nominal money supply is assumed to be constant and no fiscal policy change takes place.

2. The classical aggregate supply curve is vertical, since the classical model assumes that nominal wages adjust very quickly to changes in the price level. This implies that the labor market is always in equilibrium and output is always at the full-employment level. If the AD-curve shifts to the right, firms try to increase output by hiring more workers, who they try to attract by offering higher nominal wages. But since we are already at full employment, no more workers can be hired and firms merely bid up nominal wages. The nominal wage increase is passed on in the form of higher product prices. In the end, the level of wages and prices will have increased proportionally, while the real wage rate and the levels of employment and output will remain unchanged.

   If there is a decrease in demand, then firms try to lay off workers. Workers, in turn, are willing to accept lower wages to stay employed. Lower wage costs enable firms to lower their product prices. In the end, nominal wages and prices will decrease proportionally but the real wage rate and the level of employment and output will remain the same.

3. There is no single theory of the aggregate supply curve, which shows the relationship between firms' output and the price level. A number of competing explanations exist for the fact that firms have a tendency to increase their output level as the price level increases. The Keynesian model of a horizontal aggregate supply curve supposedly describes the very short run (over a period of a few months or less), while the classical model of a vertical aggregate supply curve is supposed to hold true for the long run (a period of more than 10 years). The medium-run aggregate supply curve is most useful for periods of several quarters or a few years. This upward-sloping aggregate supply curve results from the fact that wage and price adjustments are slow and uncoordinated. Chapter 6 offers several explanations for the fact that labor markets do not adjust quickly. These include the imperfect information market-clearing model, the existence of wage contracts or coordination problems, and the fact that firms pay efficiency wages and price changes tend to be costly.

4. The Keynesian aggregate supply curve is horizontal since the price level is assumed to be fixed. It is most appropriate for the very short run (a period of a few months or less). The classical aggregate supply curve is vertical and output is assumed to be fixed at its potential level. It is most appropriate for the long run (a period of more than 10 years) when prices are able to fully adjust to all shocks.

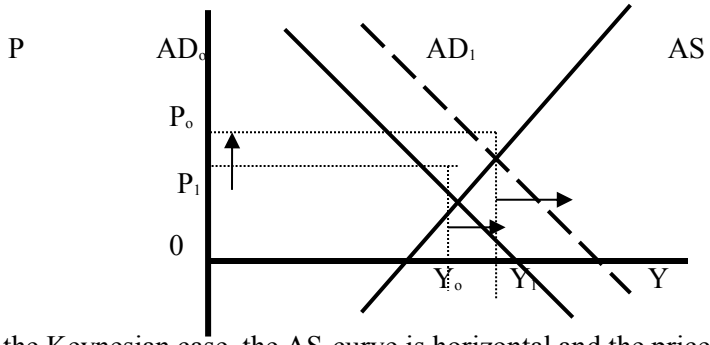
5. The aggregate supply and aggregate demand model used in macroeconomics is not very similar to the market demand and market supply model used in microeconomics. While the workings of both models (the distinction between shifts of the curves versus movement along the curves) are similar, these models are really unrelated. The "P" in the microeconomic model stands for the relative price of a good (or the ratio at which two goods are traded), whereas the "P" in the macroeconomic model stands for the average price level of all goods and services produced in this country, measured in money terms.

Technical Problems:

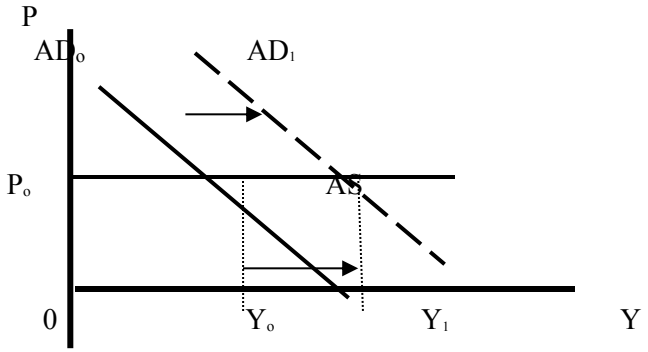
1.a. As Figure 5-9 in the text shows, a decrease in income taxes will shift both the AD-curve and the AS-curve to the right. The shift in the AD-curve tends to be fairly large and, in the short run (when prices are fixed), leads to a significant increase in output without a change in prices. In the long run, the AS-curve will also shift to the right--since lower income tax rates provide an incentive to work more--but only by a fairly small amount. Therefore we see a slightly higher real GDP with a large increase in the price level in the long run.

1.b. Supply-side economics is any policy measure that will increase potential GDP by shifting the long-run (vertical) AS-curve to the right. In the early 1980s, supply-side economists put forth the view that a cut in income tax rates would increase the incentive to work, save and invest. This would increase aggregate supply so much that the inflation and unemployment rates would simultaneously decrease. The resulting high economic growth might then even lead to an increase in tax revenues, despite lower tax rates. However, these predictions did not become reality. As seen in the answer to 2.a., the long-run effect of a tax cut on output is not very large, although it can increase long-term output to some degree.

2.a. According to the balanced budget theorem, a simultaneous and equal increase in government purchases and taxes will shift the AD-curve to the right. But if the AS-curve is upward sloping, then the balanced budget multiplier will be less than one, that is, the increase in output will be less than the increase in government expenditures. This occurs, since part of the increase in government spending will be crowded out due a higher price level, lower real money balances, and a resulting rise in interest rates.

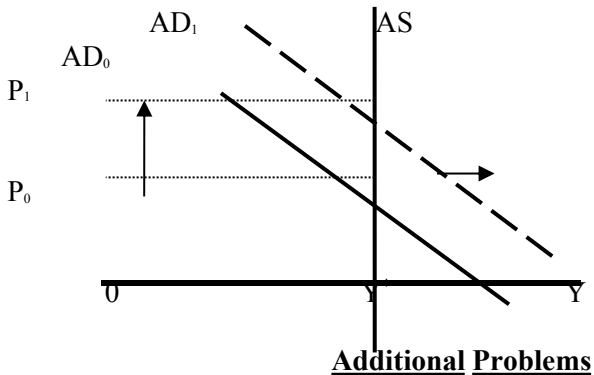


2.b. In the Keynesian case, the AS-curve is horizontal and the price level remains unchanged. There is no real balance effect and therefore income will increase more than in 3.a. However, the interest rate will still increase and therefore the balanced budget multiplier will be less than one (but greater than zero).



2.c. In the classical case, the AS-curve is vertical and the output level remains unchanged. In this case, a shift in the AD-curve leads to a price increase and real money balances decline. Therefore interest rates increase further than in 3.b., leading to full crowding out of investment. Hence the balanced budget multiplier is zero.

P



Additional Problems

1. Briefly explain why the AS-curve is upward sloping in the intermediate run?

An upward-sloping AS-curve assumes that wage and price adjustments are slow and uncoordinated. This can be explained most easily by the existence of wage contracts and imperfect competition. Because of wage contracts, wages cannot be changed easily and, since the contracts tend to be staggered, they cannot be changed all at once. In an imperfectly competitive market structure, firms are reluctant to change their prices since they cannot accurately predict the reactions of their competitors. Therefore, wages and prices will adjust only slowly. (Chapter 6 provides more elaborate explanations for this.)

2. Briefly discuss in words why the AD-curve is downward sloping.

In the AD-AS framework, we assume that nominal money supply (M) is constant unless it is changed by the Fed's monetary policy (which would result in a shift in the AD-curve). Therefore, if the price level increases, then real money (M/P) decreases, driving interest rates (i) up and lowering the level of investment spending (I). This means that total output demanded (Y) will decrease.

A more elaborate answer may include that lower real money balances (M/P) result in less real wealth, leading to a lower level of consumption (C) due to the wealth effect. This means that total output demanded (Y) will decrease. A higher domestic price level (P) also means that domestic goods will become less competitive in world markets. This will stimulate imports while reducing exports, leading to a reduction in net exports (NX), and a decrease in total output demanded (Y).

3. "In the classical aggregate supply curve model, the economy is always at the full-employment level of output and the unemployment rate is always zero." Comment on this statement.

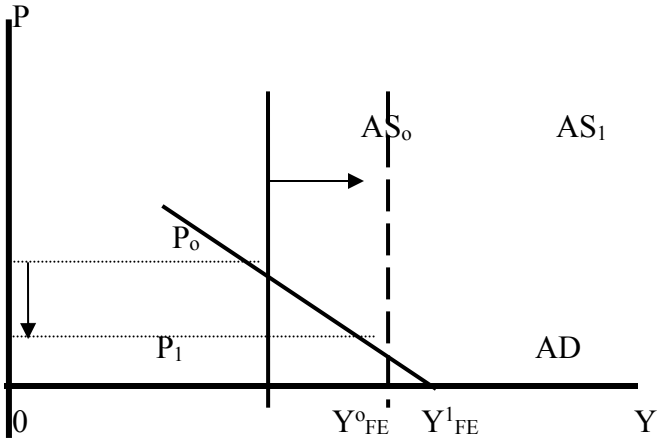
The classical aggregate supply curve model implies a vertical AS-curve at the full-employment level of output. However, this does not mean that the unemployment rate is zero. There is always some friction in the labor market, which means that there is always some (frictional) unemployment as workers switch jobs. The (positive) amount of unemployment at the full-employment level of output is called the natural rate of unemployment and is estimated to be roughly 5.5 percent for the United States; however, an exact value for this natural rate has not been established.

4. Assume a technological advance leads to lower production costs. Show the effect of such an event on national income, unemployment, inflation, and interest rates with the help of an AD-AS diagram, assuming completely flexible wage rates.

A decrease in production costs shifts the AS-curve to the right. The price level decreases, leading to a higher level of income and lower interest rates. Since wages are completely flexible, the AS-curve is vertical and we are always at full-employment (this is the classical case). This implies that the unemployment rate stays at the natural rate, but output goes up since workers are now more productive.

1.→2. Cost of prod.↑ ==> AS → Ex.S. ==> P↓ real ms ↑ i ↓ I↑ Y↑

Effect: Y↑ UR ↓ P ↓ i↓



5. "Monetary expansion will not change interest rates in the classical AS-curve model." Comment on this statement.

An increase in the nominal money supply will shift the AD-curve to the right. There will be excess demand for goods and services, which will force the price level up. In the classical AS-curve model, a new equilibrium will be established at the same level of output but at a higher price level. Real money balances will be reduced to their original level and interest rates will not be affected in the long run (the classical case).

6. "Expansionary fiscal policy does not affect the level of real output or real money balances in the classical AS-curve case." Comment on this statement.

Expansionary fiscal policy will shift the AD-curve to the right, causing excess demand for goods and services at the existing price level. This forces the price level up, reducing real money balances. Interest rates increase, which results in a lower level of investment spending. In the classical case, the AS-curve is vertical, so the level of output will not change. In other words, the increase in the level of prices and interest rates continues until private spending is reduced again to the original full-employment level.

7. "In the classical AS-curve case, a reduction in government spending will lower interest rates and the real money stock." Comment on this statement.

A decrease in government spending will shift the AD-curve to the left, causing excess supply of goods and services at the original price level. As the price level decreases to restore equilibrium, real money balances increase and interest rates fall. This will increase the level of investment spending until a new equilibrium is reached at the original level of output but at lower prices and interest rates. Thus, real money balances will rise, but interest rates fall.

8. "In the Keynesian aggregate supply curve model, the Fed, through restrictive monetary policy, can easily lower inflation without creating unemployment." Comment on this statement.

This statement is wrong. In the Keynesian aggregate supply curve model, the AS-curve is horizontal, since prices are assumed to be fixed. Restrictive monetary policy will shift the AD-curve to the left. This will reduce the level of output without any change in the price level. But a lower level of output implies a higher rate of unemployment.

9. True or false? Why?
"Monetary policy does not affect real output in the Keynesian supply curve model."

False. An increase in money supply will shift the AD-curve to the right, leading to a higher level of income. In the Keynesian supply curve model, the price level is fixed, hence real balances will not fall as they would in the classical supply curve model. We will reach a new equilibrium at a higher level of output, at a lower interest rate, but at the same price level. In this case monetary policy is not neutral.

10. Explain why there is so much interest in finding ways to shift the AS-curve to the right.

Shifting the AS-curve to the right seems to be the only way to offset the effects of an adverse supply shock without negative side effects. An adverse supply shock, such as an increase in oil prices, causes a simultaneous increase in unemployment and inflation, and policy makers have only two options for demand-management policies. Expansionary fiscal or monetary policy will help to achieve full employment faster but will raise the price level, while restrictive fiscal or monetary policy will reduce inflationary pressure but increase unemployment. Therefore, any policy that would shift the short-run AS-curve back to the right seems preferable, since it might bring the economy back to the original equilibrium by simultaneously lowering inflation and unemployment.

11. "Restrictive fiscal policy will always lower output, prices, and interest rates." Comment.

This statement is true in the intermediate run when the AS-curve is upward sloping. Restrictive fiscal policy will shift the AD-curve to the left. In the Keynesian case, the AS-curve is horizontal and prices remain constant, while both output and interest rates decrease. In the classical case, the AS-curve is vertical and the decrease in the price level will increase real money balances and interest rates. Prices will fall until spending is again consistent with the full-employment level of output. Thus in the long run, prices and interest rates will decline, while output will remain the same. Only in the intermediate run (when the AS-curve is upward sloping due to slowly adjusting wages and prices) will output, prices, and the interest rate all go down.

12. "The real impact of demand management policy is largely determined by the flexibility of wages and prices." Comment on this statement.

If wages and prices are completely flexible, then the economy will always be at the full-employment level of output, independent of the price level. In other words, we have the classical case of a vertical (long-run) AS-curve. In this case, a shift in the AD-curve will affect only the price level but not the level of output. However, if wages and prices are completely inflexible, then we have the (horizontal) Keynesian aggregate supply curve. In this case, any shift of the AD-curve will have a large effect on the level of output but will not affect the price level. Only in the intermediate run, when we have an upward-sloping AS-curve, will the level of output and the price level both be affected by a shift in the AD-curve. More flexibility in wages and prices implies a steeper the AS-curve. Therefore the effect of a shift in the AD-curve will be smaller on output and larger on the price level.

13. "An increase in the income tax rate will lower the level of output and increase the price level." Comment on this statement.

Supply siders argue that a decrease in income taxes will shift both the AD-curve and the AS-curve to the right (as shown in Figure 5-10). Conversely, an increase in the income tax rate will shift the AD-curve and the AS-curve to the left. The shift in the AD-curve will be fairly large and, in the medium run, will lead to a significant decrease in output without a (significant) change in the price level. However, in the long run, the AS-curve will also shift to the left, since higher income tax rates provide a disincentive to work. Since the AS-curve will shift only by a fairly small amount, we will see a slightly lower real GDP with a large decrease in the price level.

Chapter 6
Solutions to the Problems in the Textbook:

Conceptual Problems:

1. The aggregate supply curve and the Phillips curve describe very similar relationships and both curves can be used to analyze the same phenomena. The AS-curve shows a relationship between the price level and the level of output. The Phillips curve shows a relationship between the rate of inflation and the unemployment rate, given certain inflationary expectations. For example, a movement along the AS-curve depicts an increase in the price level that is associated with an increase in the level of output. As output increases, the rate of unemployment decreases (see Okun's law). Therefore, with a larger increase in the price level (a higher level of inflation) there will be a decrease in unemployment, creating a downward-sloping Phillips curve. This downward sloping Phillips curve shifts whenever inflationary expectations change. If one assumes that workers will change their wage demands whenever their inflationary expectations change, one can conclude that a shift in the Phillips curve corresponds to a shift in the upward sloping AS-curve, since higher wages mean higher cost of production.

2. In the short run, when wages and prices are assumed to be fixed, there can be no inflation and thus the Phillips curve makes no sense over this very brief time frame. But in the medium run (in this chapter also often referred to as the short run), the Phillips curve is

downward sloping as inflationary expectations are assumed to be constant. In the long run, the Phillips curve is vertical at the natural rate of unemployment, which corresponds to the vertical long-run AS-curve at the full-employment level of output.

3. A variety of explanations are given in this chapter for the stickiness of wages in the short or intermediate run. One is that workers have imperfect information and nobody knows the actual price level. People don't know whether a change in their nominal wage is the result of an increase in prices or in the real wage they receive for the work they provide. Due to this uncertainty, labor markets will not clear immediately. Another argument relies on coordination problems, that is, different firms within an economy cannot coordinate price changes in response to monetary policy changes. Individual firms change their prices only reluctantly, since they are afraid of losing market share. The efficiency wage theory argues that employers pay above market-clearing wages to motivate their workers to work harder. Firms are also reluctant to change wages because of the perceived menu costs involved. There are long-term relations between firms and workers and wages are usually set in nominal terms by wage contracts, which are renegotiated only periodically. Thus real wages fluctuate over time as the price level changes. Finally, the insider-outsider model argues that firms negotiate only with their own employees but not with unemployed workers. Since a turnover in the labor force is costly to firms, they are willing to offer above market-clearing wages to the currently employed rather than hiring the unemployed who may be willing to work for lower wages.

These different views are not necessarily mutually exclusive and it is up to students to decide which of the arguments presented here they find most plausible. The explanations differ mainly in their assumption of how fast markets clear and whether employment variations are voluntary.

4.a. Stagflation is defined as a period of high unemployment accompanied by high inflation.

4.b. Stagflation can occur in time periods when people have high inflationary expectations. If the economy goes into a recession, the actual rate of inflation will fall below the expected rate of inflation. However, the actual inflation rate may still be very high while the rate of unemployment is increasing. For example, the Fed may have let money supply grow much too fast in the past, so everyone expects a high inflation rate. If a supply shock occurs, we will see an increase in the rate of unemployment while inflationary

expectations and actual inflation remain very high. This scenario occurred during the 1970s. Once we have reached such a situation, it becomes necessary to design policies that will reduce inflationary expectations to shift the Phillips curve back to the left.

5. Assume a disturbance occurs and the AD-curve shifts to the right. Unemployment decreases and inflation increases, and we move along the downward sloping Phillips curve to the left. However, as soon as people realize that actual inflation is higher than their inflationary expectations, they adjust their inflationary expectations upward and the downward-sloping Phillips curve shifts to the right, eventually returning unemployment back to its natural rate. In other words, the economy adjusts back at the full-employment level of income.

If an adverse supply shock occurs (the upward-sloping AS-curve shifts to the left), unemployment and inflation increase simultaneously. This will correspond to a shift of the downward-sloping Phillips curve to the right. However, when people realize that actual inflation is less than expected inflation, then the downward-sloping Phillips curve starts to shift back and the economy adjusts back to the natural rate of unemployment in the long run.

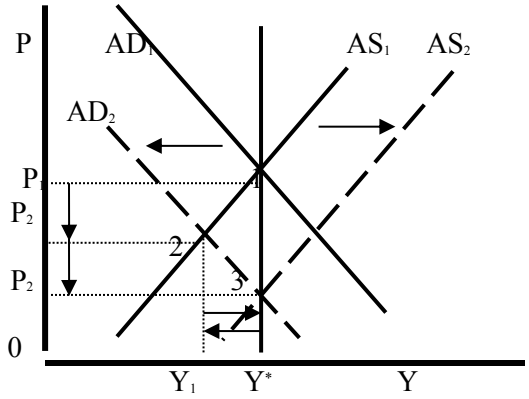
6. The expectations-augmented Phillips curve predicts that inflation will rise above the expected level when unemployment drops below its natural rate. However, if people know that this is going to happen, why don't they immediately adjust to it? And if people immediately adjusted to it, wouldn't this imply that anticipated monetary policy would be ineffective to cause any deviation from the full-employment level of output? In reality, however, even if people have rational expectations, they may not be able to adjust immediately. One reason is that wage contracts often set wages for an extended time period. Similarly, prices cannot always be changed right away and the costs of changing prices may outweigh the benefits. A further argument is that even rational people make forecasting mistakes and learn only slowly.

   In other words, the location of the expectations-augmented Phillips curve is determined by the level of expected inflation, which is set by recent historical experience. A shift in this curve caused by changing inflationary expectations occurs only gradually. The rational expectations model, on the other hand, assumes that the Phillips curve shifts almost instantaneously as new information about the near future becomes available.

Technical Problems:

1. A reduction in the supply of money leads to excess demand for money and increased interest rates, reducing the level of private spending (especially investment). Therefore

the AD-curve shifts to the left. This causes an excess supply of goods and services at the original price level so the price level starts to decrease. Since the AS-curve is upward sloping, a new short-run macro-equilibrium is reached at a lower level of output (and thus a higher level of unemployment) and a lower price level.

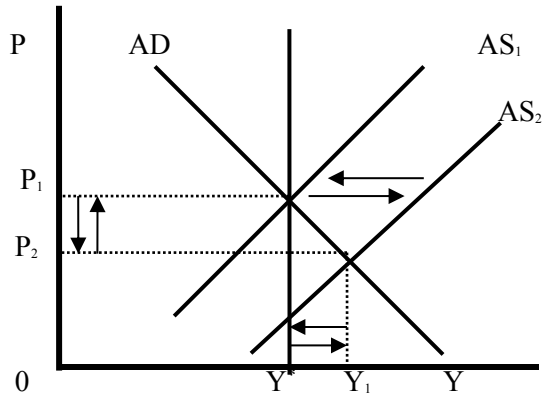


However, the higher level of unemployment eventually puts downward pressure on wages, reducing the cost of production and shifting the upward-sloping AS-curve to the right. Alternatively, since this equilibrium output level is below the full-employment level, prices will continue to fall, and the upward-sloping AS-curve will shift to the right. As long as output is below the full-employment level Y^*, the upward-sloping AS-curve will continue to shift to the right, which means that the price level will continue to decline. Eventually a new long-run equilibrium will be reached at the full-employment level of output (Y^*) and a lower price level.

2. According to the rational expectations theory, an announced change in monetary policy would immediately change people's perception in regard to the expected inflation rate. If people could adjust immediately to this change in inflationary expectations, then the rate of unemployment or the output level would remain the same. In other words, we would immediately move from point 1 to point 3 in the diagram used to explain the previous question and the Fed would be unable to affect the unemployment rate. In reality, however,

even if people have rational expectations and can anticipate the effects of a policy change correctly, they may not be able to immediately adjust due to wage contracts, etc. Thus, there will always be some deviation from the full-employment output level Y*.

3.a. A favorable supply shock, such as a decline in material prices, shifts the upward-sloping AS-curve to the right, leading to excess supply at the existing price level. A new short-run equilibrium is reached at a higher level of output and a lower price level. But since output is now above the full-employment level Y^*, there is upward pressure on wages and prices and the upward-sloping AS-curve shifts back to the right. A new long-run equilibrium is reached back at the original position (Y^*), and the original price level (assuming that the change in material prices did not affect the full-employment level of output). Since nominal wages (W) will have risen but the price level (P) will not have changed, real wages (W/P) will have increased.



3.b. Lower material prices lower the cost of production, shifting the upward-sloping AS-curve shifts to the right, and leading to an increase in output and a lower price level. Since unemployment is now below its natural rate, there is a shortage of labor, providing upward pressure on wages. This will increase the cost of production again, eventually shifting the upward-sloping AS-curve back to the original long-run equilibrium (assuming that potential GDP has not been affected).

Additional Problems:

1. Explain the long-run effect of an increase in nominal money supply on the amount of real money balances available in the economy.

In the very short run, the price level is fixed, so if nominal money supply (M) increases, a higher level of real money balances is available, causing interest rates to fall and the level of investment spending to increase. This leads to an increase in aggregate demand. The shift to the right of the AD-curve causes the price level (P) to increase, leading to a reduction in real money balances (M/P). In the medium run (an upward-sloping AS-curve), we reach a new equilibrium at a higher output level and a higher price level. Since prices have gone up proportionally less than nominal money supply, real money balances have increased. However, to reach a new long-run equilibrium, prices have to increase further, and as a result, the level of real money balances will decrease further. When the new long-run equilibrium at Y^* is finally reached, the price level will have risen proportionally to nominal money supply and the level of real money balances will be back at its original level.

2. Assume the economy is in a recession. Describe an adjustment process that will ensure that the economy eventually will return to full employment. How can the government speed up this process?

If the economy is in a recession, there will be downward pressure on wages and prices, which will bring the economy back to the full-employment output level. The upward-sloping AS-curve will shift to the right due to lower production costs. However, this process may take a fairly long time. The government can shorten this adjustment process with the help of expansionary fiscal or monetary policies to stimulate aggregate demand. The resulting shift to the right of the AD-curve implies that the final long-run equilibrium will be at a higher price level. In other words, the reduction in unemployment can only be achieved at the cost of higher inflation.

3. "The stickiness of wages implies that policy makers can achieve low unemployment only if they are willing to put up with high inflation." Comment on this statement.

There are several explanations of why wages and prices adjust only slowly. One is that workers have imperfect information, so they do not realize that lower prices mean higher real wages. Another is that firms are reluctant to change prices and wages since they are unsure about the behavior of their competitors and want to avoid the perceived cost of making these changes. Finally, wage contracts tend to be long-term and staggered, so it takes time to adjust wages to price changes. Some firms may pay their workers above market-clearing wages to keep them happy and productive. For these reasons, wages and prices tend to be rigid in the short run. Thus it takes time for the economy to adjust back to full-employment.

If there were a stable Phillips-curve relationship, a low rate of unemployment could only be achieved by allowing inflation to increase. However, such a stable relationship does not exist. Wages tend to be rigid in the short run, so expansionary policies lower unemployment and increase inflation in the short run. In the long run, however, the economy will adjust back to the natural rate of unemployment, so expansionary policies simply lead to a higher price level.

4. "If we assume that people have rational expectations, then fiscal policy is always irrelevant. But monetary policy can still be used to affect the rate of inflation and unemployment." Comment on this statement.

Individuals and firms with rational expectations consistently make optimal decisions based on all information available. As long as a policy change is anticipated, people are able to assess its long-run

outcome and will try to immediately adjust. Since fiscal policy doesn't affect inflation or unemployment in the long run, it is also ineffective in the short run if wages and prices are assumed to be flexible. An anticipated change in monetary growth, on the other hand, will be reflected in a change in the inflation rate. If wages are flexible, workers will adjust their wage demands immediately and no significant change in the unemployment rate will occur. However, even if people have rational expectations, wages tend to be fairly rigid in the short run due to wage contracts. Therefore, it will take time for the economy to adjust back to a long-run equilibrium. This implies that both fiscal and monetary policy can affect the rate of inflation and unemployment to some degree in the short run.

5. "Inflation cannot accelerate in a recession, when the rate of unemployment is above its natural rate." Comment on this statement.

Inflation can accelerate even in a recession, that is, when the unemployment is high, if a supply shock occurs. An oil price increase will increase the cost of production, so the upward-sloping AS-curve will shift to the left. This will increase the inflation rate and the rate of unemployment simultaneously, as firms increase their product prices and cut their production. If the Fed tries to accommodate the supply shock with expansionary monetary policy in an effort to stimulate the economy, then inflation will accelerate even more, as the AD-curve shifts to the right.

6. Comment on the following statement:

"The coordination approach to the Phillips curve focuses on the problems that the administration has in coordinating its fiscal policies with the monetary policies of the Fed."

The coordination approach has nothing to do with fiscal or monetary policy but is simply one explanation of why wages adjust slowly. This view asserts that firms generally are unable to coordinate wage and price changes in response to a monetary policy change. For example, any firm that cuts workers' wages in response to monetary contraction while other firms don't, will anger its employees who may then choose to leave. Firms are also reluctant to change their prices since they are unsure about their competitors' behavior. Thus wages and prices change only slowly in response to a change in aggregate demand. This implies an upward-sloping (short-run) AS-curve.

7. Comment on the following statement:

"The unemployment rate is zero at the full-employment level of output."

With a higher price level real wages decline, increasing the quantity of labor demanded. Therefore the nominal wage rate is bid up until the real wage rate is restored to its unique equilibrium level. Similarly, if prices fall, real wages increase, leading to unemployment. The nominal wage rate falls to bring the real wage rate back to its equilibrium level. So the nominal wage rate changes in proportion to the price level to maintain a real wage rate that clears the labor market. At this wage rate, the full-employment level of output is produced. However, at the full-employment output level the unemployment rate is not zero. Due to

frictions in the labor market, there is always a positive unemployment rate, as workers switch between jobs. This is called the natural rate of unemployment.

8. Briefly state the reason for the slow adjustment of wages to changes in aggregate demand.

The reasons for the slow adjustment of nominal wages can be explained in several ways. One explanation is that workers have imperfect information, that is, they do not immediately realize whether a change in their nominal wage is the result of an increase in prices or in the real wage they receive for the work they provide. Another explanation is that coordination problems exist, that is, different firms within an economy are unsure about the behavior of their competitors and thus they only reluctantly change wages or prices. The efficiency wage theory, on the other hand, argues that firms pay above market-clearing wages to motivate their workers to work harder. Firms are also reluctant to change wages due to the perceived cost of doing so. Another argument is that wage contracts tend to be long-term, so real wages tend to fluctuate over the length of the contract and output adjusts only slowly to price changes. Finally, the insider-outsider model argues that firms negotiate only with their employees but not the unemployed. Since a turnover of the labor force is costly to firms, they are willing to offer above market-clearing wages to the currently employed rather than hiring the unemployed who may be willing to work for less. These various explanations are not mutually exclusive, and they all imply that the AS-curve is positively sloped, that is, that a change in aggregate demand will affect both output and prices in the short run.

9. True or false? Why?
"There is no frictional unemployment at the natural rate of unemployment."

False. The natural rate of unemployment is the rate at which the labor market is in equilibrium. But there is always some unemployment due to new entrants into the labor force, people between jobs, and the like. This rate of unemployment is considered normal, due to frictions in the labor market, and is often called frictional unemployment.

10. "If everyone in this economy had rational expectations, then wages would be flexible and unemployment could not occur." Comment on this statement.

The new Keynesian models argue that even if people have rational expectations, socially undesirable outcomes may still occur due to imperfect competition and the existence of wage contracts. Prices may not change freely, since firms in imperfectly competitive markets are reluctant to change them, due to the menu costs involved. Nominal wages are set by contracts over a period of time, so the economy may adjust only slowly to a decrease in aggregate demand. Thus a rate of unemployment higher than the natural rate can exist over an extended period of time.

11. True or false? Why?
"If nominal wages were more flexible, expansionary policies would be more effective in reducing the rate of unemployment."

False. In Chapter 5 we learned that in the classical case (where nominal wages are completely flexible) the AS-curve is vertical, whereas in the Keynesian case (where wages do not change,

even if unemployment persists) the AS-curve is horizontal. From this we can conclude that more flexible nominal wages imply a steeper upward-sloping AS-curve. Any type of expansionary demand-side policy will shift the AD-curve to the right and this will cause the level of output and prices to increase (at least in the short-run). A steeper upward-sloping AS-curve results in a larger price increase and a smaller increase in output. But a smaller increase in the level of output results in a smaller reduction in unemployment. In either case, the economy will settle back at the full-employment level of output in the long run. In the long run, the rate of unemployment always goes back to its natural level.

12. Explain the short-run and long-run effects of an increase in the level of government spending on output, unemployment, interest rates, prices, and real money balances.

An increase in government spending increases aggregate demand, shifting the AD-curve to the right. Because there is excess demand, the price level increases, which reduces the level of real money balances. Therefore interest rates increase, leading to some crowding out of investment. Due to this real balance effect, the increase in output is less than the shift in the AD-curve. Assuming an upward-sloping AS-curve, a new equilibrium is reached at a higher price level, a higher level of output, a lower unemployment rate and a higher interest rate. Since output is now above the full-employment level, wages and prices will continue to rise and the upward-sloping AS-curve will start shifting to the left. This process will continue until a new long-run equilibrium is reached at the full-employment level of income Y^*, that is, until unemployment is back at its natural rate. At this point the price level, nominal wages, and interest rates will be higher than previously and real money balances will be lower.

13. Briefly explain why there seems to be so much interest in finding ways to shift the upward-sloping aggregate supply curve to the right.

Shifting the upward-sloping AS-curve to the right seems to be the only way to offset the effects of an adverse supply shock without any negative side effects. An adverse supply shock, such as an increase in oil prices, causes a simultaneous increase in unemployment and inflation, and policy makers have only two options for demand-management policies. Expansionary fiscal or monetary policy will help to achieve full employment faster but will raise the price level, while restrictive fiscal or monetary policy will reduce inflationary pressure but increase unemployment. Therefore, any policy that would shift the upward sloping AS-curve back to the right seems preferable, since it might bring the economy back to the original equilibrium by simultaneously lowering inflation and unemployment.

14. Use an AD-AS framework to show the effect of monetary restriction on the level of output, prices and the interest rate in the medium and the long run.

A decrease in nominal money supply will increase interest rates, leading to a decrease in investment spending. This will shift the AD-curve to the left, creating an excess supply of goods and services. Therefore price level will decrease and real money balances will increase. A new equilibrium will be achieved at the intersection of the new AD-curve and the upward-sloping AS-curve at an output level that is below the full-employment level.

In the long run, higher unemployment will cause downward pressure on wages. As the cost of production decreases, the upward-sloping AS-curve will keep shifting to the right until a new long-run equilibrium is established at the full-employment level of output, that is, where the new AD-curve intersects the long-run vertical AS-curve at Y^*. At this point, real output, the real interest rate, real money balances, and the real wage rate will be back at their original level. Nominal money supply, the price level and the nominal wage rate will all have decreased proportionally.

A simplified adjustment can be shown as follows:

1-->2: Ms down ==> i up ==> I down ==> Y down ==> the AD-curve shifts left ==>

excess supply ==> P down ==> real ms up ==> i down ==> I up ==> Y up

(The first line describes a policy change, that is, a shift in the AD-curve; the second line describes the price adjustment, that is, a movement along the AD-curve.)

Short-run effect: Y down, i up, P down

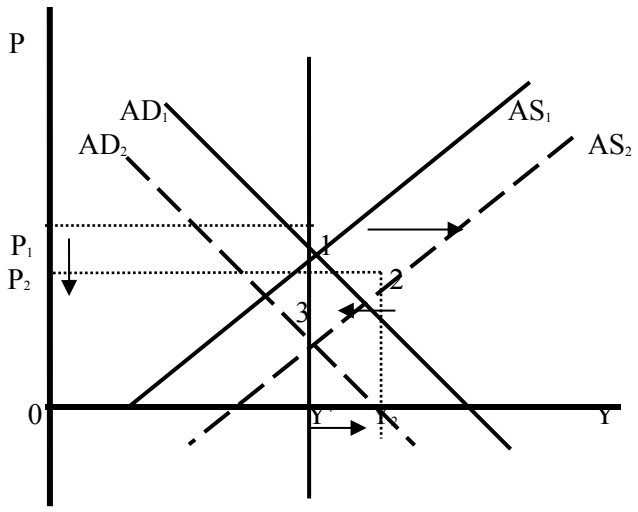
2-->3: Since $Y < Y^*$ ==> downwards pressure on nominal wages ==> cost of production down ==>

the short run AS-curve shifts right ==> excess supply of goods ==> P down ==> real ms up

==> i down ==> I up ==> Y up (This process continues until $Y = Y^*$)

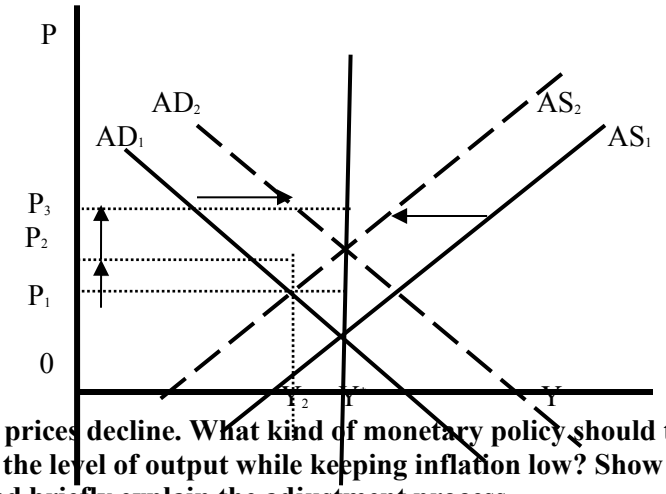
Long-run effect: Y stays at Y^*, i remains the same, P down.

Note: Even though only one shift of the short-run AS-curve to the new long-run equilibrium is shown here, this shift is actually a combination of many shifts.

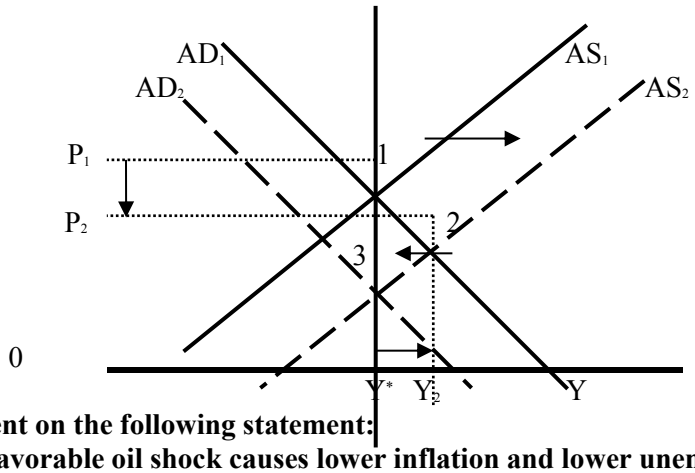


15. Briefly discuss the importance of Okun's law in evaluating the cost of unemployment.
Okun's law states that a reduction in the unemployment rate of 1 percent will increase the level of output by about 2 percent. This relationship allows us to measure the cost to society (in terms of lost production) of a given rate of unemployment.

16. True or false? Why?
If monetary policy accommodates an adverse supply shock, it will worsen any inflationary effects."
True. An adverse supply shock shifts the upward-sloping AS-curve to the left. There is excess demand for goods and services at the original price level and prices start to rise, leading to lower real money balances, higher interest rates, and lower output. If no policy is implemented, then unemployment will force the nominal wage down to restore equilibrium at the original position. If the government views this adjustment process as too slow, it can respond by implementing expansionary policies. Accommodating the supply shock in this way shifts the AD-curve to the right and a new equilibrium can be reached at full-employment but at a higher price level. It is unlikely, though, that the economy will remain there for long since workers will realize that their purchasing power has been diminished by higher prices and will demand a wage increase. If they are successful, the cost of production will increase and the upward-sloping AS-curve will shift to the left again. In other words, we will enter a wage-price spiral.



17. Assume oil prices decline. What kind of monetary policy should the Fed undertake if its goal is to stabilize the level of output while keeping inflation low? Show with the help of an AD-AS diagram and briefly explain the adjustment process.
1-->2: As oil prices decline, the cost of production decreases and the upward-sloping AS-curve shifts to the right, causing excess supply of goods. Thus the price level decreases, real money balances increase, and the interest rate declines.
2-->3: A decrease in money supply will increase the interest rate, decrease private spending, and shift the AD-curve to the left. This means that prices will decrease even further and the level of output will decline. (We assume, for simplicity, that it goes back to the full-employment level Y^*, so no long-run adjustment is needed.) Overall, the level of output has remained at its full-employment level but the level of prices and the interest rate have decreased.



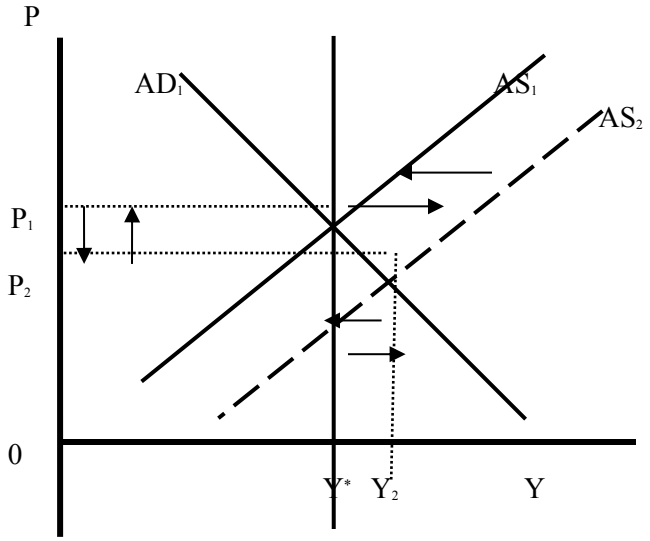
18. Comment on the following statement:

"A favorable oil shock causes lower inflation and lower unemployment."

A decrease in material prices (or any other favorable supply shock) shifts the upward-sloping AS-curve to the right, and prices begin to decrease. The new equilibrium is at a lower price level and a higher level of output (a lower level of unemployment). Since output is now above the full-employment level, there will be upward pressure on nominal wages and prices, and the upward-sloping AS-curve will start shifting back to its original position (assuming that potential output was not affected). In the long run, unemployment will be back at its natural rate but the price level will have decreased (and thus real wages increased).

19. "Falling oil prices will lead to increased employment, higher wage rates and increased real money balances." Comment on this statement with the help of an AD-AS diagram and explain the short-run and long-run adjustment processes.

A decline in material prices shifts the upward-sloping AS-curve to the right, leading to excess supply at the existing price level. A new equilibrium is reached at a higher level of output and a lower price level. But since output is now above the full-employment level Y^*, there is upward pressure on wages and prices and the upward-sloping AS-curve starts shifting back to the right. A new long-run equilibrium is reached back at the original position (Y^*), and the original price level (assuming that the change in material prices did not affect the full-employment level of output). Since nominal wages (W) will have risen but the price level (P) will not have changed, real wages (W/P) will have increased.



Chapter 7
Solutions to the Problems in the Textbook:

Conceptual Problems:

1. The rate of unemployment is affected by the frequency, that is, the number of times that workers become unemployed in a period, and by the duration, that is, the length of the period for which workers are unemployed.

1.a. In depressed industries, the duration of unemployment is likely to be long but the frequency is likely to be low. Policies to help unemployed workers from these industries find new jobs may include retraining and education programs to enable them to find work in other industries.

1.b. Unskilled workers tend to be more frequently unemployed, but the duration of their unemployment is usually fairly short. On-the-job training or education programs that provide skills to obtain or maintain jobs are often the best strategy for helping these workers. However, such programs are often costly and difficult to implement.

1.c. Unemployment in depressed geographical areas tends to be of long duration and low frequency and is often concentrated in specific industries (very similar to the situation in 1.a.). Policies to relocate workers to different geographical areas may not be successful since workers are often reluctant to move. Thus policy makers generally prefer programs designed to attract new industries to an area over programs to relocate workers.

1.d. Teenage unemployment is often of high frequency and short duration. Since teenagers tend to have few skills and little or no work experience, programs to facilitate the transition into the adult work force are needed. Programs that offer on-the-job training will provide the highest long-term benefits. These programs tend to be fairly costly, however, which is why some politicians advocate lowering the minimum wage for teenagers instead.

2. The natural unemployment rate is determined by two factors: the duration and frequency of unemployment. While the duration of unemployment depends primarily on the organization and demographic make-up of the labor force, the availability of unemployment benefits, and the desire of the unemployed to look for better jobs, the frequency of unemployment depends largely on the rate at which new workers enter the work force and on the variability of the demand for labor across different employers.

2.a. It is unclear whether the elimination of unions would serve to reduce the natural rate of unemployment. The insider-outsider theory of the labor market suggests that firms bargain with unions (the insiders) and are not much concerned with the unemployed (the outsiders). If unions were eliminated, firms would tend to hire unemployed workers at a lower wage rate, thus reducing the natural unemployment rate. On the other hand, unions tend to preserve stable jobs for their members. Eliminating them may lead not only to a reduction in bargaining power for labor in wage negotiations but also to an increase in the natural rate of unemployment. The elimination of labor unions could also serve to eliminate the wage differentials between unionized and non-unionized workers and, in the process, redistribute some income.

2.b. Increased labor force participation of teenagers would at least initially increase the natural rate of unemployment, since teenagers have a higher frequency of unemployment than older, more experienced workers. However, as more and more teenagers entered the labor force and more good and stable jobs became available to them, the natural rate of unemployment would start to decline again. But with more people in the labor force, the supply of labor would be higher and wage rates would be driven down, contributing to wage stagnation.

2.c. If aggregate demand fluctuated more, then firms would offer fewer stable jobs and the frequency of unemployment would increase, increasing the natural rate. This would not only lead to a loss in

output and an increase in personal hardship, but it would also put more financial strain on the unemployment insurance program.

2.d. An increase in unemployment benefits would make it less urgent for the unemployed to find new jobs. They would have the option of looking longer for jobs after being laid off and would be less likely to accept undesirable job offers. As the length of their unemployment increased, workers might begin to look less desirable to potential employers who might believe that they lacked either the motivation or qualifications to work hard for them. Therefore the natural rate of unemployment would increase.

2.e. Employers who perceive the minimum wage rate to be above the value of the marginal product of low skilled workers will not hire such workers. The elimination of the minimum wage rate might induce some firms to hire more low-skilled workers, thus decreasing the natural rate of unemployment. However, the wage rate that these low skilled workers were offered might be well below the amount that would ensure an adequate standard of living.

2.f. If fluctuation in the composition of aggregate demand increased, workers would have to be shifted from industry to industry more often and this would increase the natural rate of unemployment. However, since skills are not always transferable, resources would have to be devoted to retraining programs.

3. Many unemployed teenagers are new entrants into the labor force and their frequency of unemployment is higher than that of adult workers. Teenagers' frequency of entry into and exit from the labor force indicates that few of them work at jobs with the promise of high job security. They have little or no training and few job skills and thus tend to hold unattractive jobs. This perpetuates the problem since the jobs they can get do not provide the skills needed to gain better jobs in the future.

While the frequency of unemployment is lower for adults than teenagers, the duration is often higher. There are fewer entrants and re-entrants into the work force among adults, who are most often unemployed due to layoffs. Overall, the unemployment rate for adults is much lower than the unemployment rate for teenagers.

4.a. Employers would benefit from a lower minimum wage rate, since they would be able to expand production by hiring labor at a lower cost. Since the nominal minimum wage rate might no longer be above the value of the marginal product of low skilled or inexperienced workers, the labor of these workers would be more desirable to employers. Therefore teenagers and low skilled job seekers would also benefit. They would get jobs more easily and gain valuable work experience that they otherwise might not have gotten. Since more people would be hired and more output would be produced at a lower price, the whole economy would benefit from a lower inflation rate and a lower unemployment rate.

4.b. Those workers who would have been working at jobs paying the existing minimum wage rate might lose from a decrease in the minimum wage. With a lower minimum wage rate implemented only during the summer months, employers might lay off current workers and replace them with new entrants at a lower cost. Thus the number of displaced workers might increase.

4.c. Obviously, those who would gain from such a policy measure would support it--teenagers, low skilled workers, and some firms.

5. It is possible to design a restrictive fiscal and monetary policy mix to bring the economy to a long-run equilibrium situation at the natural rate of unemployment and at a zero rate of inflation. However, this cannot be achieved without an increase in the rate of unemployment in the short run. Therefore a choice has to be made among adjustment paths that differ in their inflation-unemployment mix.

In considering adjustment paths, the benefits of permanently lower inflation have to be compared with the costs of increased short-term unemployment. The costs of unemployment are loss of output and personal hardship. If inflation can be anticipated only imperfectly, then a redistribution of income and wealth will take place. Some output may be lost as resources are devoted to minimizing a potential loss in purchasing power rather than to actual production. However, the cost of perfectly anticipated inflation is minimal. Thus it probably makes little difference whether we have a zero inflation rate or an inflation rate of 3%, as long as a specific long-run goal is established. A positive rate of inflation may actually help in wage and price adjustments, since it allows real wages to adjust more easily to supply shocks.

Most policy makers tend to perceive the cost of inflation as lower than the cost of an increase in unemployment resulting from tough anti-inflation policies. However, the U.S. experience of the early 1980s indicates that tough measures to bring the economy quickly to recovery may be acceptable if inflation reaches the double-digit range. One way to establish a clear inflation goal is for the Fed to follow a monetary growth rule. However, such a rule may not perform well in all situations (for example, in a supply shock). Another option is to maintain discretionary monetary policy along with an independent central bank that has a clear mandate to function as an inflation fighter.

6. The sacrifice ratio is the percentage of output lost for each one- percent reduction in the inflation rate. It is non-zero in the short and medium runs, when output is different from the full-employment level. However, in the long run, unemployment always returns to its natural level and therefore the sacrifice ratio is zero.

7. Okun's law states that a reduction in the unemployment rate of 1 percent will increase the level of output by 2 percent. This relationship allows us to measure the cost to society (in terms of lost production) of a given rate of unemployment.

8. When inflation is perfectly anticipated, then its costs consist primarily of the costs of making price changes (menu costs) and costs related to the holding of currency, which loses purchasing power. If there is only low to moderate inflation, these costs are very low. However, when inflation rates soar, the costs can be substantial.

9. The cost of imperfectly anticipated inflation can be serious. There is a redistribution of wealth among individuals. If actual inflation is higher than expected, debtors profit while creditors lose as real interest rates are lower than expected. Equity holders are also hurt, since the real value of dividends and capital gains is reduced. If there is no tax indexation, people may move into higher tax brackets and suffer financially due to bracket creep.

10. Indexation is designed to make it easier to live with inflation since it eliminates the cost of unanticipated inflation. In practice, however, indexing on a broad basis makes it more complicated to calculate contracts. It also makes it harder for the economy to adjust to shocks if changes in relative prices are needed. This is particularly true for supply shocks. Finally, there is some concern that indexation may weaken political motivation to fight inflation. However, as long as inflation is low to moderate, the benefits of indexation probably outweigh the costs.

Technical Problems:

1.a. The aggregate unemployment rate can be calculated by adding the unemployment rates of different groups weighted by their share of the labor force. The data in the problem indicate that 10% of the

labor force are teenagers. The adult work force (the other 90%) is divided into 35% females and 65% males. Thus we get

$u = (0.1)(0.19) + (0.9)[(0.35)(0.06) + (0.65)(0.07)] = 0.019 + (0.9)(0.021 + 0.0455)$
$= 0.019 + 0.05985 = 0.07885 = 7.9\%$.

1.b. If the labor force participation rate of teenagers increases to 15%, then the aggregate rate of unemployment changes to:

$u_1 = (0.15)(0.19) + (0.85)[(0.35)(0.06) + (0.65)(0.07)]$
$= 0.0285 + (0.85)(0.021 + 0.0455) = 0.0285 + 0.056525 = 0.085025 = 8.5\%$.

2. The unemployment figures for each group were taken from the *Economic Report of the President*, February, 1997. Figures relating to the unemployment rate were taken from Table B-40 and each group's share in the civilian labor force was calculated from Table B-38.

	1986	**1991**	**1996**
Males 16-19			
Un.Rt./Share	(19.0%)/(.030)	(19.8%)/(.026)	(18.1%)/(.026)
Females 16-19			
Un.Rt./Share	(17.6%)/(.029)	(17.5%)/(.024)	(15.2%)/(.025)
Males 20+			
Un.Rt./Share	(6.1%)/(.525)	(6.4%)/(.520)	(4.6%)/(.512)
Females 20+			
Un.Rt./Share	(6.2%)/(.416)	(5.7%)/(.430)	(4.8%)/(.437)

If the unemployment rate for each group in the two other years was the same as in 1991, then the overall unemployment rate in 1986 or 1996 would have been:

$u_{86} = (19.8\%)(.030) + (6.4\%)(.525) + (17.5\%)(.029) + (5.7\%)(.416)$
$= 0.594\% + 3.360\% + 0.508\% + 2.371\% = 6.83\%$
$u_{96} = (19.8\%)(.026) + (6.4\%)(.512) + (17.5\%)(.025) + (5.7\%)(.437)$
$= 0.515\% + 3.277\% + 0.438\% + 2.491\% = 6.72\%$

The actual unemployment rates for these years were:

$u_{86} = 7.0\%$ $u_{91} = 6.8\%$ $u_{96} = 5.4\%$

The difference between the unemployment rates calculated above and the unemployment rate in 1986 shows the effects of changes in the composition of the labor force on the rate of unemployment.

3. The data mentioned here were taken from the *Economic Report of the President*, February, 1997. Table B-42 of the report shows unemployment by duration. In 1991 the average duration was 13.7 weeks, in 1995 it was 16.6 weeks, and in 1996 it was 16.7 weeks. (These numbers reflect the average amount of time that an unemployed worker was out of work in a given year and not the duration of a completed spell of unemployment.) For the years in question, the overall unemployment rates were 6.8% in 1991, 5.6% in 1995, and 5.4% in 1996. Thus the duration of unemployment moved in the opposite direction from the overall unemployment rate.

• CHAPTER 8

Solutions to the Problems in the Textbook:

Conceptual Problems:

1. The first question you should ask yourself as a policy maker is whether a disturbance is transitory or persistent. You should then ask yourself how long it would take to put a suggested policy measure into effect and how long it will take for the policy to have the desired effect on the economy. In addition, you need to know how reliable the estimates of your advisors are about the effects of the policy. If a disturbance is small and probably transitory, you may be best advised to do nothing, because any measure you take is likely to have its effect after the economy has recovered. Therefore your action might only further aggravate the problem.

2.a. The inside lag is the time it takes after an economic disturbance has occurred to recognize and implement a policy action that will address the disturbance.

2.b. The inside lag is divided into three parts. First, there is the recognition lag, that is, the time it takes for policy makers to realize that a disturbance has occurred and that a policy response is warranted. Second, there is the decision lag, that is, the time it takes to decide on the most desirable policy response after a disturbance is recognized. Finally, there is the action lag, that is, the time it takes to actually implement the policy measure.

2.c. Inside lags are shorter for monetary policy than for fiscal policy since the FOMC meets on a regular basis to discuss and implement monetary policy. Fiscal policy, on the other hand, has to be initiated and passed by both houses of the U.S. Congress and this can be a lengthy process. The exceptions are the so-called automatic stabilizers; however, they only work well for small and transitory disturbances

2.d Automatic stabilizers have no inside lag; they are endogenous and function without specific government intervention. Examples are the income tax system, the welfare system, unemployment insurance, and the Social Security system. They all reduce the amount by which output changes in response to an economic disturbance.

3.a. The outside lag is the time it takes for a policy action, once implemented, to have its full effect on the economy.

3.b. Generally, the outside lag is a distributed lag with a small immediate effect and a larger overall effect over a longer time period. The effect is spread over time, since aggregate demand responds to any policy change only slowly and with a lag.

3.c. Outside lags are longer for monetary policy since monetary policy actions affect short-term interest rates most directly, while aggregate demand depends heavily on lagged values of income, interest rates, and other economic variables. A change in government spending, however, immediately affects aggregate demand.

4. Fiscal policy has smaller outside lags, but significant inside lags. Monetary policy, on the other hand has smaller inside lags and longer outside lags. Therefore large open market operations should be undertaken to get an immediate effect, but they should be partially reversed over time to avoid a large long-run effect. If the shock is sufficiently transitory and small, policy makers may be best advised not to undertake any policy change at all.

5.a. An econometric model is a statistical description of all or part of the economy. It consists of a set of equations that are based on past economic behavior.

5.b. Econometric models are generally used to forecast the behavior of the economy and the effects of alternative policy measures.

5.c. There is considerable uncertainty about how well econometric models actually represent the workings of the economy. There is also great uncertainty about the expectations of firms and consumers and their reactions to policy changes. Any policy is bound to fail if the information on which it was based is poor.

6. The answer to this question is student specific. The main difficulties of stabilization policy arise from three sources. First, policy always works with lags. Second, the outcome of any policy depends on the way the private sector forms expectations and how those expectations affect the public's behavior. Third, there is considerable uncertainty about the structure of the economy and the shocks that hit it.
It can be argued that a monetary policy rule would greatly reduce uncertainty about the Fed's policy responses. If the government behaved in a consistent way, then the private sector would also behave more consistently and economic fluctuations could be greatly reduced. A monetary growth rule would also reduce any political pressure the administration might exert on the Fed. It is often initially unclear whether a disturbance is temporary or persistent and a monetary policy rule would prevent policy mistakes in cases where the disturbance is, in fact, temporary. If active monetary policy is applied to a temporary disturbance, then the lags involved will guarantee that the economy will actually be destabilized.
On the other hand, the workings of the economy are not completely understood and events cannot always be predicted. Thus it is difficult to argue for a fixed policy rule. Unanticipated large disturbances warrant an activist policy, especially if they appear to be persistent. It is also possible to construct a more activist monetary growth rule. For example, Equation (8) suggests that the annual monetary growth rate should be increased by two percent for every one percent that unemployment increases above its natural rate. Such a rule is based on the quantity theory of money equation (which relates money supply growth to the growth of nominal GDP) and on Okun's law (which relates the unemployment rate to economic growth). Obviously, because of the long lags for monetary policy, any monetary growth rule will work much better in the long run than in the short run.
Fiscal policy rules may make more sense than monetary policy rules, since fiscal policy has long inside lags but shorter outside lags. In a way, built-in stabilizers, although generally not considered "rules", already provide some stability without any inside lag. Many of the arguments against monetary policy rules are also valid for fiscal policy rules and many economists oppose them. The frequently proposed constitutional amendment requiring an annually balanced budget is an example of a fiscal policy rule. There are significant problems associated with such an amendment, since it would greatly limit the government's ability to undertake active fiscal stabilization policy.

7. The arguments for a constant growth rate rule for money are based on the quantity theory of money equation, that is,

$MV = PY$.

From this equation we can derive

$\%\Delta P = \%\Delta M - \%\Delta Y + \%\Delta V$.

If the long-run trend rate of real output (Y) and the long-run trend of velocity (V) are assumed to be fairly stable, and if wages and prices are sufficiently flexible, then a constant monetary growth rate (M) would insure a constant rate of inflation, that is, a constant rate of change in the price level (P). Also, since monetary policy has long outside lags, active monetary policy can actually be more destabilizing than stabilizing. In addition, since we do not know exactly how the economy works or may react to specific policies, it is best to follow a rule rather than undertake actions that have uncertain outcomes. However, rules are not without problems, as they would not allow flexibility in responding to major disturbances.

8. Dynamic inconsistency occurs if, after having committed themselves to a specific policy action designed to achieve a long-run objective, policy makers find themselves in a situation where it seems advantageous to abandon their original policy, in order to achieve a short-run goal. Such action will impede the long-run objective.

9. Real GDP targeting is the best option if the primary policy goal of monetary policy is to achieve full employment. If policy makers forecast potential GDP correctly, then full employment combined with low inflation can be achieved. However, real GDP targeting bears the greater risk that the secondary goal of achieving a low inflation rate will be missed. If the rate at which potential GDP grows is overestimated, then policy makers may stimulate the economy too much. In this case, they will not be successful in achieving price stability. By targeting nominal GDP, the central bank creates a policy tradeoff between inflation and unemployment. If the rate at which potential GDP grows is overestimated and policy makers stimulate the economy too much, we will get less growth but also less inflation than under real GDP targeting. Which targeting approach should be chosen depends greatly on how steep or flat the Phillips curve is perceived to be.

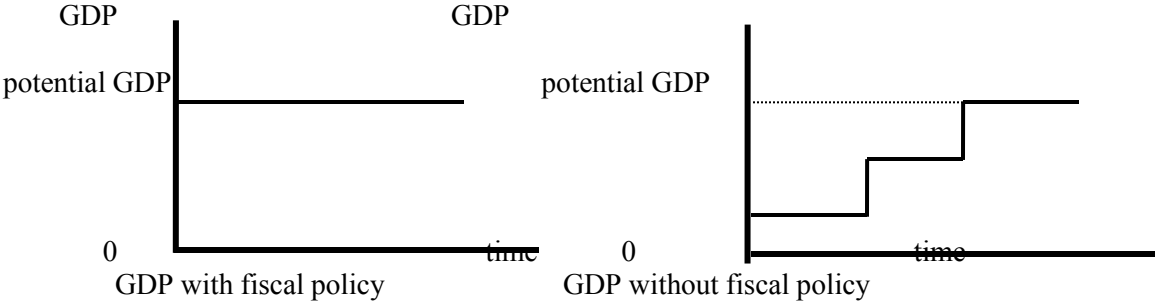
Technical Problems:

1. If actual GDP is expected to be $40 billion below the full-employment level and the size of the government spending multiplier is 2, then government spending should be increased by $20 billion over its current level. For the next period, when actual GDP is expected to be $20 billion below potential, government spending should be cut by $10 billion from its new level, that is, to $10 billion over its original level. In period three, when actual GDP is expected to be at its full-employment level, the level of government spending should again be cut by $10 billion from the last period's level to bring it back to the original level of Period 0.

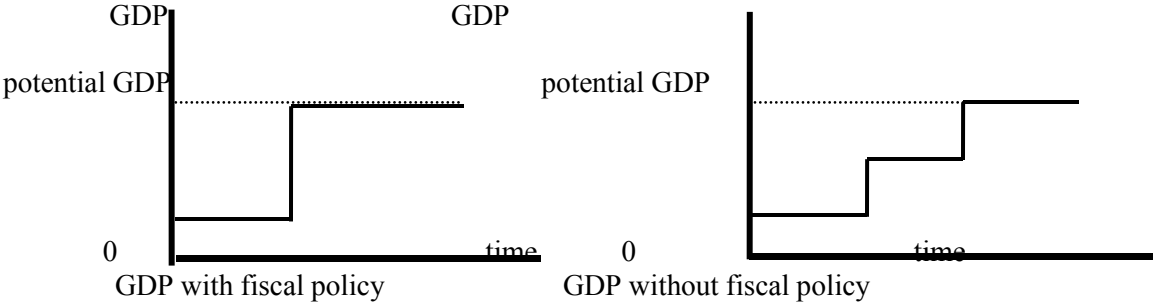
2.a. If there is a one-period outside lag for government spending, then nothing can be done to close the current GDP-gap. The government should decide to spend $10 billion more for the next period and reduce spending again to its original level after that.

2.b. Graph I below shows the path of GDP for Problem 1 with no outside lag and Graph II shows the path of GDP for problem 2.a. with a one-period outside lag. In each of the graphs the path of actual GDP is shown, first assuming that no policy action takes place and then assuming that the policies proposed in Problems 1 and 2.a. are undertaken.

Graph I



Graph II



3.a. Since the government multiplier for the first period is 1, the level of government spending must be increased by ΔG = \$40 billion to close the GDP-gap of \$40 billion. But since the government multiplier in the next period for the amount spent in this period is 1.5, the effect of an increase in government spending in the first period by \$40 billion would be an increase in GDP by \$60 billion in the second period.

3.b. For the second period a GDP-gap of \$20 billion is expected. However, as we saw in 3.a., GDP will increase by \$60 billion in the second period if the government increases spending by \$40 billion in the first period. Therefore, the government has to reduce spending in the second period by \$40 billion from its new level (back to its original level), since the multiplier for a spending change in the same period is 1.

3.c. In this problem, fiscal policy has an outside lag. This means that the effect of an increase in government spending is felt both in the period in which the spending increase takes place and (to an even larger degree) in the following period. The increase in government spending needed to close the GDP-gap in the first period is guaranteed to overshoot the desired goal in the next period. Thus the government will be forced to reverse its increase in spending to the original level in the second period to offset the destabilizing effect. In a case like this, the government has to be much more active in its fiscal policy than in a situation where no distributed lag exists.

4. If there is uncertainty about the size of the multiplier, then fiscal policy becomes much more complicated. If the multiplier is 1, then an increase in government spending by $40 billion will close the GDP-gap in the first period. If the multiplier is 2.5, we will overshoot potential GDP by $60 billion. An increase in spending by 40/2.5 = $16 billion is optimal if the multiplier is 2.5. Thus a cautious government will probably increase spending by no more than $16 billion in the first period, and then reduce the level of spending by $8 billion in the next period ($8 billion above the original level). Such a policy action is designed to close the GDP-gap to some degree over the first two periods while never overshooting potential GDP. In Period 3 we will again be back at the full-employment level. The extent to which a less cautious government might exceed these suggested spending increases depends largely on that government's level of concern about unemployment versus inflation.

5. To follow an established rule for its policy, the Fed needs to know the source of each disturbance. If a disturbance comes from the goods sector, it is better to have a monetary growth target; if the disturbance comes from the money sector, it is better to have an interest rate target.

a. Assume a disturbance comes from the money sector. If an increase in money demand increases the interest rate, the Fed should try to maintain a constant interest rate by increasing the supply of money. This will re-establish the old equilibrium values of the interest rate and output and effectively offset the disturbance.

b. Assume a disturbance comes from the goods sector. If an increase in autonomous investment increases the interest rate, then it is not advisable to maintain a constant interest rate. Trying to lower the interest rate again by increasing the money supply would aggravate the disturbance. On the other hand, maintaining a constant money supply, while not offsetting the disturbance, will at least not make things worse.

6.a. Students will have to check the *Federal Reserve Bulletin in* early 2000 and compare the forecasts of the Federal Reserve Board with the actual performance of the economy in 1999.

6.b. Regardless of how detailed it is, no econometric model can accurately represent the economy, since we do not completely understand the way the economy works. Therefore, we can never expect perfect forecasts. It is impossible to incorporate all the relevant information on which individuals and firms base their expectations about the future and to determine how these expectations affect actions in any given situation. Forecasts are generally based on the information available at the time, which may be flawed or outdated. In addition, any unexpected change, such as a supply shock, an unanticipated international change, or an unanticipated domestic policy change, can render the initial predictions wrong.

CHAPTER 9
INCOME AND SPENDING
Solutions to the Problems in the Textbook:

Conceptual Problems:

1. In the Keynesian model, the price level is assumed to be fixed, that is, the AS-curve is horizontal and the level of output is determined solely by aggregate demand. The classical model, on the other hand, assumes that prices always fully adjust to maintain a full-employment level of output, that is,

the AS-curve is vertical. Since the model of income determination in this chapter assumes that the price level is fixed, it is a Keynesian model.

2. An autonomous variable's value is determined outside of a given model. In this chapter the following components of aggregate demand have been specified as being autonomous: autonomous consumption (C*) autonomous investment (I_o), government purchases (G_o), lump sum taxes (TA_o), transfer payments (TR_o), and net exports (NX_o).

3. Since it often takes a long time for policy makers to agree on a specific fiscal policy measure, it is quite possible that economic conditions may drastically change before a fiscal policy measure is implemented. In these circumstances a policy measure can actually be destabilizing. Maybe the economy has already begun to move out of a recession before policy makers have agreed to implement a tax cut. If the tax cut is enacted at a time when the economy is already beginning to experience strong growth, inflationary pressure can be created.
While such internal lags are absent with automatic stabilizers (income taxes, unemployment benefits, welfare), these automatic stabilizers are not sufficient to replace active fiscal policy when the economy enters a deep recession.

4. Income taxes, unemployment benefits, and the welfare system are often called automatic stabilizers since they automatically reduce the amount by which output changes as a result of a change in aggregate demand. These stabilizers are a part of the economic mechanism and therefore work without any case-by-case government intervention. For example, when output declines and unemployment increases, there may be an increase in the number of people who fall below the poverty line. If we had no welfare system or unemployment benefits, then consumption would drop significantly. But since unemployed workers get unemployment compensation and people living in poverty are eligible for welfare payments, consumption will not decrease as much. Therefore, aggregate demand may not be reduced by as much as it would have without these automatic stabilizers.

5. The full-employment budget surplus is the budget surplus that would exist if the economy were at the full-employment level of output, given the current spending or tax structure. Since the size of the full-employment budget surplus does not depend on the position in the business cycle and only changes when the government implements a fiscal policy change, the full-employment budget surplus can be used as a measure of fiscal policy. Other names for the full-employment budget surplus are the structural budget surplus, the cyclically adjusted surplus, the high-employment surplus, and the standardized employment surplus. These names may be preferable, since they do not suggest that there is a specific full-employment level of output that we were unable to maintain.

Technical Problems:

1.a. AD = C + I = 100 + (0.8)Y + 50 = 150 + (0.8)Y
The equilibrium condition is Y = AD ==>
Y = 150 + (0.8)Y ==> (0.2)Y = 150 ==> Y = 5*150 = **750**.

1.b. Since TA = TR = 0, it follows that S = YD - C = Y - C. Therefore
S = Y - [100 + (0.8)Y] = - 100 + (0.2)Y ==> S = - 100 + (0.2)750 = - 100 + 150 = **50.**

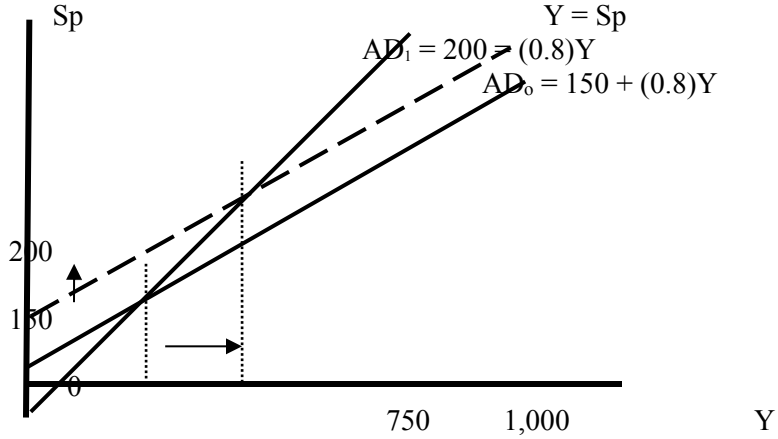
1.c. If the level of output is Y = 800, then AD = 150 + (0.8)800 = 150 + 640 = **790.**
Therefore the amount of involuntary inventory accumulation is UI = Y - AD = 800 - 790 = **10**.

1.d. AD' = C + I' = 100 + (0.8)Y + 100 = 200 + (0.8)Y
From Y = AD' ==> Y = 200 + (0.8)Y ==> (0.2)Y = 200 ==> Y = 5*200 = 1,000
Note: This result can also be achieved by using the multiplier formula:

ΔY = (multiplier)(ΔSp) = (multiplier)(ΔI) ==> $\Delta Y = 5*50 =$ **250**,
that is, output increases from $Y_o = 750$ to $Y_1 = 1{,}000$.

1.e. From 1.a. and 1.d. we can see that the multiplier is **5**.

1.f.



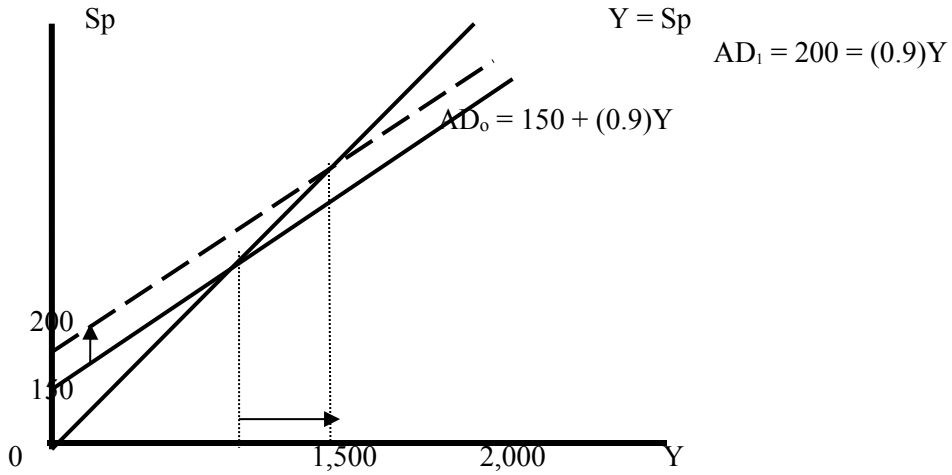
2.a. Since the mpc has increased from 0.8 to 0.9, the size of the multiplier is now larger and we should therefore expect a higher equilibrium income level than in 1.a.

AD = C + I = 100 + (0.9)Y + 50 = 150 + (0.9)Y ==>
Y = AD ==> Y = 150 + (0.9)Y ==> (0.1)Y = 150 ==> Y = 10*150 = **1,500**.

2.b. From ΔY = (multiplier)(ΔI) = 10*50 = 500 ==> $Y_1 = Y_o + \Delta Y = 1{,}500 + 500 =$ **2,000**.

2.c. Since the size of the multiplier has doubled from 5 to **10**, the change in output (Y) that results from a change in investment (I) now has also doubled from 250 to **500**.

2.d.



3.a. AD = C + I + G + NX = 50 + (0.8)YD + 70 + 200 = 320 + (0.8)[Y - (0.2)Y + 100]
= 400 + (0.8)(0.8)Y = 400 + (0.64)Y
From Y = AD ==> Y = 400 + (0.64)Y ==> (0.36)Y = 400
==> Y = (1/0.36)400 = (2.78)400 = **1,111.11**
The size of the multiplier is (1/0.36) = **2.78**.

3.b. BS = tY - TR - G = (0.2)(1,111.11) - 100 - 200 = 222.22 - 300 = **- 77.78**

3.c. AD' = 320 + (0.8)[Y - (0.25)Y + 100] = 400 + (0.8)(0.75)Y = 400 + (0.6)Y
From Y = AD' ==> Y = 400 + (0.6)Y ==> (0.4)Y = 400 ==> Y = (2.5)400 = **1,000**
The size of the multiplier is now reduced to **2.5**.

3.d. BS' = (0.25)(1,000) - 100 - 200 = - 50
BS' - BS = - 50 - (-77.78) = **+ 27.78**

The size of the multiplier and equilibrium output will both increase with an increase in the marginal propensity to consume. Therefore income tax revenue will also go up and the budget surplus should increase.

3.e. If the income tax rate is t = 1, then all income is taxed. There is no induced spending and equilibrium income only increases by the change in autonomous spending, that is, the size of the multiplier is 1.

From $Y = C + I + G \Rightarrow Y = C_o + c(Y - 1Y + TR_o) + I_o + G_o$

$\Rightarrow \quad Y = C_o + cTR_o + I_o + G_o = A_o$

4. In Problem 3.d. we had a situation where the following was given:

$Y = 1{,}000, \quad t = 0.25, \quad G = 200 \quad$ and $\quad BS = -50.$

Assume now that $t = 0.3$ and $G = 250 \Rightarrow$

$AD' = 50 + (0.8)[Y - (0.3)Y + 100] + 70 + 250 = 370 + (0.8)(0.7)Y + 80 = 450 + (0.56)Y.$

From $Y = AD' \Rightarrow Y = 450 + (0.56)Y \Rightarrow (0.44)Y = 450$

$\Rightarrow Y = (1/0.44)450 =$ **1,022.73**

$BS' = (0.3)(1{,}022.73) - 100 - 250 = 306.82 - 350 = -43.18$

$BS' - BS = -43.18 - (-50) =$ **+ 6.82**

The budget surplus has increased, since the increase in tax revenue is larger than the increase in government purchases.

5.a. While an increase in government purchases by $\Delta G = 10$ will change intended spending by $\Delta Sp = 10$, a decrease in government transfers by $\Delta TR = -10$ will change intended spending by a smaller amount, that is, by only $\Delta Sp = c(\Delta TR) = c(-10)$. The change in intended spending equals $\Delta Sp = (1 - c)(10)$ and equilibrium income should therefore increase by

$\Delta Y =$ (multiplier)$(1 - c)10$.

5.b. If $c = 0.8$ and $t = 0.25$, then the size of the multiplier is

$\alpha = 1/[1 - c(1 - t)] = 1/[1 - (0.8)(1 - 0.25)] = 1/[1 - (0.6)] = 1/(0.4) =$ **2.5**.

The change in equilibrium income is

$\Delta Y = \alpha(\Delta A_o) = \alpha[\Delta G + c(\Delta TR)] = (2.5)[10 + (0.8)(-10)] = (2.5)2 =$ **5**

5.c. $\Delta BS = t(\Delta Y) - \Delta TR - \Delta G = (0.25)(5) - (-10) - 10 =$ **1.25**

Additional Problems:

1. **"An increase in the marginal propensity to save increases the impact of one additional dollar in income on consumption." Comment on this statement. In your answer discuss the effect of such a change in the mps on the size of the expenditure multiplier.**

The fact that the marginal propensity to save (1 - c) has risen implies that the marginal propensity to consume (c) has fallen. This means that now one extra dollar in income earned will affect consumption by less than before the reduction in the mpc. When the mpc is high, one extra dollar in income raises consumption by more than when the mpc is low. If the mps is larger, then the expenditure multiplier will be larger, since the expenditure multiplier is defined as 1/(1-c).

2. **Using a simple model of the expenditure sector without any government involvement, explain the paradox of thrift that asserts that a desire to save may not lead to an increase in actual saving.**

The paradox of thrift occurs because the desire to increase saving leads to a lower consumption level. But a lower level of spending sends the economy into a recession and we get a new equilibrium at a lower level of output. In the end, the increase in autonomous saving is exactly offset by the decrease in induced saving due to the lower income level. In other words, the economy is in equilibrium when $S = I_o$. Since

the level of autonomous investment (I_o) has not changed, the level of saving at the new equilibrium income level must also equal I_o.

This can also be derived mathematically. Since an increase in desired saving is equivalent to a decrease in desired consumption, that is, $\Delta C_o = -\Delta S_o$, the effect on equilibrium income is

$\Delta Y = [1/(1 - c)](\Delta C_o) = [1/(1 - c)](-\Delta S_o)$.

Therefore the overall effect on total saving is

$\Delta S = s(\Delta Y) + \Delta S_o = [s/(1 - c)](-\Delta S_o) + \Delta S_o = 0$, since $s = 1 - c$.

3. "When aggregate demand falls below the current output level, an unintended inventory accumulation occurs and the economy is no longer in an equilibrium." Comment on this statement.

If aggregate demand falls below the equilibrium output level, production exceeds desired spending. When firms see an unwanted accumulation in their inventories, they respond by reducing production. The level of output falls and eventually reaches a level at which total output equals desired spending. In other words, the economy eventually reaches a new equilibrium at a lower value of output.

4. For a simple model of the expenditure sector without any government involvement, derive the multiplier in terms of the marginal propensity to save (s) rather than the marginal propensity to consume (c). Does this formula still hold when the government enters the picture and levies an income tax?

In the text, the expenditure multiplier for a model without any government involvement was derived as

$\alpha = 1/(1 - c)$.

But since the marginal propensity to save is $s = 1 - c$, the multiplier now becomes $\alpha = 1/s = 1/(1-c)$.

In the text, we have also seen that if the government enters the picture and levies an income tax, then the simple expenditure multiplier changes to

$\alpha = 1/[1 - c(1 - t)] = 1/(1 - c')$.

By substituting $s = 1 - c$, this equation can be easily manipulated, to get

$\alpha' = 1/[1 - c + ct] = 1/[s + (1 - s)t] = 1/s'$.

Just as $s = 1 - c$, we can say that $s' = 1 - c'$, since

$s' = 1 - c' = 1 - c(1 - t) = 1 - c + ct = s + (1 - s)t$.

This can also be derived in another way:

$S = YD - C = YD - (C^* + cYD) = - C^* + (1 - c)YD = - C^* + sYD$

If we assume for simplicity that $TR = 0$ and $NX = 0$, then

$S + TA = I + G \implies - C^* + sYD + TA = I^* + G^* \implies$

$s(Y - tY - TA^*) + tY + TA^* = C^* + I^* + G^* \implies$

$[s + (1 - s)t]Y = C^* + I^* + G^* - (1 - s)TA^* = A^* \implies$

$Y = (1/[s + (1 - s)t])A^* = (1/s')A^*$.

5. The balanced budget theorem states that the government can stimulate the economy without increasing the budget deficit if an increase in government purchases (G) is financed by an equivalent increase in taxes (TA). Show that this is true for a simple model of the expenditure sector without any income taxes.

If taxes and government purchases are increased by the same amount, then the change in the budget surplus can be calculated as

$\Delta BS = \Delta TA_o - \Delta G = 0$, since $\Delta TA_o = \Delta G$.

The resulting change in national income is

$\Delta Y = \Delta C + \Delta G = c(\Delta YD) + \Delta G = c(\Delta Y - \Delta TA_o) + \Delta G$

$= c(\Delta Y) - c(\Delta TA_o) + \Delta G = c(\Delta Y) + (1 - c)(\Delta G)$ since $\Delta TA_o = \Delta G$.

$\Longrightarrow \quad (1 - c)(\Delta Y) = (1 - c)(\Delta G) \quad \Longrightarrow \quad \Delta Y = \Delta G$

In this case, the increase in output (Y) is exactly of the same magnitude as the increase in government purchases (G). This occurs since the decrease in the level of consumption due to the higher lump sum tax has exactly been offset by the increase in the level of consumption caused by the increase in income.

6. Assume a model without income taxes and in which the only two components of aggregate demand are consumption and investment. Show that, in this case, the two equilibrium conditions Y = C + I and S = I are equivalent.

We can derive the equilibrium value of output by setting actual income equal to intended spending, that is,

$Y = C + I \Longrightarrow Y = C^* + cY + I^* \Longrightarrow (1 - c)Y = C^* + I^* \Longrightarrow Y = [1/(1 - c)](C^* + I^*) = [1/(1 - c)]A^*$.

But since $S = YD - C = Y - [C^* + cY] = - C^* + (1 - c)Y$,

we can derive the same result from

$S = I^* \Longrightarrow S = - C^* + (1 - c)Y = I^*$

$\Longrightarrow \quad (1 - c)Y = C^* + I^* \Longrightarrow Y = [1/(1 - c)](C^* + I^*) = [1/(1 - c)]A^*$.

7. In an effort to stimulate the economy in 1976, President Ford asked Congress for a $20 billion tax cut in combination with a $20 billion cut in government purchases. Do you consider this a good policy proposal? Why or why not?

This is not a good policy proposal. According to the balanced budget theorem, equal decreases in government purchases and taxes will decrease rather than increase income. Therefore the intended result would not be achieved.

8. Assume the following model of the expenditure sector:

$Sp = C + I + G + NX$ $C = 420 + (4/5)YD$ $YD = Y - TA + TR$ $TA = (1/6)Y$

$TR_o = 180$ $I_o = 160$ $G_o = 100$ $NX_o = - 40$

(a) Assume the government would like to increase the equilibrium level of income (Y) to the full-employment level $Y^* = 2{,}700$. By how much should government purchases (G) be changed?

(b) Assume we want to reach $Y^* = 2{,}700$ by changing government transfer payments (TR) instead. By how much should TR be changed?

(c) Assume you increase both government purchases (G) and taxes (TA) by the same lump sum of $\Delta G = \Delta TA_o = + 300$. Would this change in fiscal policy be sufficient to reach the full-employment level of output at $Y^* = 2{,}700$? Why or why not?

(d) Briefly explain how a decrease in the marginal propensity to save would affect the size of the expenditure multiplier.

a. $Sp = C + I + G + NX = 420 + (4/5)[Y - (1/6)Y + 100] + 160 + 180 - 40$

$= 720 + (4/5)(5/6)Y + 80 = 800 + (2/3)Y$

From $Y = Sp \Longrightarrow Y = 800 + (2/3)Y \Longrightarrow (1/3)Y = 800 \Longrightarrow Y = 3*800 = 2{,}400$

$\Longrightarrow$ the expenditure multiplier is $\alpha = 3$

From $\Delta Y = \alpha(\Delta A_o) \Longrightarrow \quad 300 = 3(\Delta A_o) \Longrightarrow (\Delta A_o) = 100$

Thus government purchases should be changed by **$\Delta G = \Delta A_o = 100$**.

b. Since $\Delta A_o = 100$ and $\Delta A_o = c(\Delta TR_o)$ ==>$100 = (4/5)(\Delta TR_o)$ ==> $\mathbf{\Delta TR_o = 125}$.

c. This is a model with income taxes, so the balanced budget theorem does not apply in its strictest form, which states that an increase in government purchases and taxes by a certain amount increases national income by that same amount, leaving the budget surplus unchanged. Here total tax revenue actually increases by more than 100, since taxes are initially increased by a lump sum of 100, but then income taxes also change due to the change in income. Thus income does not increase by $\Delta Y = 300$, as we can see below.

$$\Delta Y = \alpha(\Delta G) + \alpha[(-c)(\alpha TA_o) = 3*300 + 3*[-(4/5)300] = 900 - 720 = 180$$

This change in fiscal policy will increase income by only $\mathbf{\Delta Y = 180,}$ from $Y_0 = 2{,}400$ to $Y_1 = 2{,}580$, and we will be unable to reach $Y^* = 2{,}700$.

d. If the marginal propensity to save decreases, people spend a larger portion of their additional disposable income, that is, the mpc and the slope of the [C+I+G+NX]-line increase. This will lead to an increase in the expenditure multiplier and equilibrium income.

9. Assume a model with income taxes similar to the model in Problem 9 above. This time, however, you have only limited information about the model, that is, you only know that the marginal propensity to consume out of disposable income is c = 0.75, and that total autonomous spending is $A_o = 900$, such that $Sp = A_o + c'Y = 900 + c'Y$. You also know that you can reach the full-employment level of output at $Y^* = 3{,}150$ by increasing government transfers by a lump sum of $\Delta TR = 200$.

(a) What is your current equilibrium level?

(b) Is it possible to determine the size of the expenditure multiplier with the information you have?

(c) Assume you want to change the income tax rate (t) in order to reach the full-employment level of income $Y^* = 3{,}150$. How would this change in the income tax rate affect the size of the expenditure multiplier?

a. Since $\Delta A = c(\Delta TR) = (0.75)200 = 150$,

the new [C+I+G+NX]-line is of the form $Sp_1 = 1{,}050 + c_1Y$.

For each model of the expenditure sector we can derive the equilibrium level of income by using the following equation:

$Y^* = \alpha A_o = 1/(1-c')$ ==> $3{,}150 = \alpha 1{,}050$ ==> the expenditure multiplier is $\mathbf{\alpha = 3}$.

If we now change autonomous spending by $\Delta A = 150$, then income will have to change by

$\Delta Y = \alpha(\Delta A)$ ==> $\Delta Y = 3*150 = \mathbf{450.}$

Therefore the old equilibrium level of income must have been $Y = 3{,}150 - 450 = \mathbf{2{,}700}$.

b. From our work above we can see that the size of the multiplier is $\alpha = \mathbf{3}$.

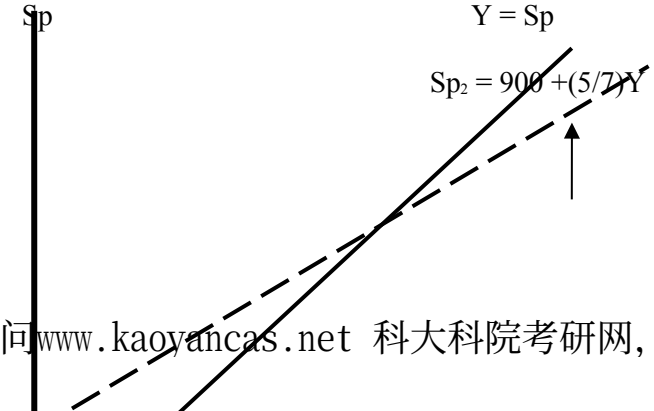
c. The new [C+I+G+NX]-line is of the form $Sp_2 = 900 + c_2Y$. This new intended spending line intersects the 45-degree line at $Y = 3{,}150$. Thus the slope of the new intended spending line can be derived as

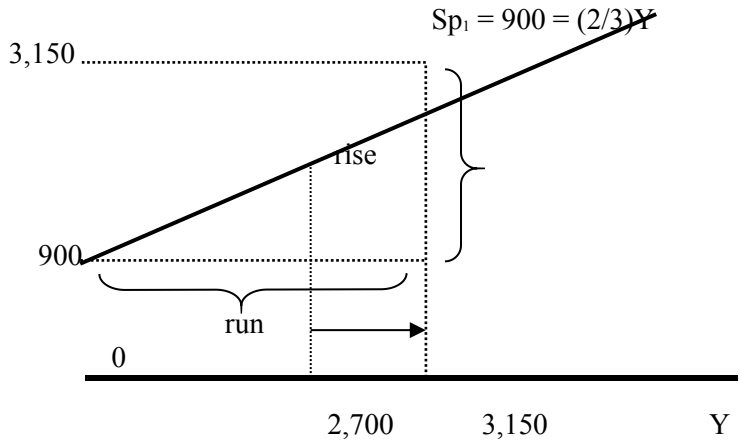
$c_2 = (3{,}150 - 900)/(3{,}150) = 5/7$.

From $Y = Sp_2$ ==> $Y = 900 + (5/7)Y$ ==> $(2/7)Y = 900$ ==>

$Y = (7/2)900 = (3.5)900 = 3{,}150$.

The new value of the multiplier is **3.5**





10. Assume you have the following model of the expenditure sector:

Sp = C + I + G + NX C = 400 + (0.8)YD I_o = 200 G_o = 300 + (0.1)(Y^* - Y)

YD = Y - TA + TR NX_o = - 40 TA = (0.25)Y TR_o = 50

(a) What is the size of the output gap if potential output is at Y^* = 3,000?

(b) By how much would investment (I) have to change to reach equilibrium at Y^* = 3,000, and how does this change affect the budget surplus?

(c) From the model above you can see that government purchases (G) are counter-cyclical, that is they are increased as national income decreases. If you compare this specification of G with a constant level of G, how is the value of the expenditure multiplier affected?

(d) Assume the equation for net exports is changes such that NX_o = - 40 is now NX_1 = - 40 - mY, with 0 < m < 1. How would this affect expenditure multiplier?

a. Sp = 400 + (0.8)YD + 200 + 300 + (0.1)(3,000 - Y) - 40
= 1,160 + (0.8)(Y - (0.25)Y + 50) - (0.1)Y = 1,200 + [(0.8)(0.75) - (0.1)]Y = 1,200 + (0.5)Y

Y = Sp ==> Y = 1,200 + (0.5)Y ==> (0.5)Y = 1,200 ==>Y = 2*1,200 = 2,400

The output gap is Y^* - Y = 3,000 - 2,400 = **600**.

b. From ΔY = (mult.)(ΔA) ==> 600 = 2(ΔI) ==> **ΔI = 300**

BuS = TA - TR - G = (0.25)(2,400) - 50 - [300 + (0.1)(600)] = 600 - 50 - 300 - 60 = 190

BuS^* = (0.25)(3,000) - 50 - 300 = 400, so the budget surplus increases by **ΔBuS = 210.**

c. If government purchases are used as a stabilization tool, the size of the multiplier should be lower than if the level of government spending is fixed. In the model of the expenditure sector above, the slope of the [C+I+G+NX]-line is c' = 0.5 compared to c" = 0.6, when government purchases were defined as G = 300.

d. With this change, net exports decrease as national income increases. This additional leakage implies that the size of the multiplier will decrease. In the model above, the slope of the [C+I+G+NX]-line decreases from c' = (0.5) to c" = (0.5) - m. Therefore the expenditure multiplier will decrease from 1/[1 - (0.5)] to 1/[1 - (0.5) + m].

11. Assume you have the following model of the expenditure sector:

Sp = C + I + G + NX $C = C_o + cYD$ YD = Y - TA + TR TA = TA_o

TR = TR_o I = I_o

G = G_o NX = NX_o

(a) If a decrease in income (Y) by 800 leads to a decrease in savings (S) by 160, what is the size of the expenditure multiplier?

(b) If a decrease in taxes (TA) by 400 leads to an increase in income (Y) by 1,200, how large is the marginal propensity to save?

(c) If an increase in imports by 200 ($\Delta NX = -200$) leads to a decrease in consumption (C) by 800, what is the size of the expenditure multiplier?

Recall that the expenditure multiplier for such a simple model can be calculated as:

$\alpha = 1/(1 - c)$

a. $(\Delta S)/(\Delta Y) = 1 - c = (-160)/(-800) = .2 \Rightarrow 1/(1 - c) = 1/(.2) = 5$ ==> the multiplier is $\boldsymbol{\alpha = 5}$.

b. From $(\Delta Y) = \alpha[-c(\Delta TA_o)] \Rightarrow (\Delta Y)/(\Delta TA_o) = (-c)\alpha = (-c)/(1 - c) \Rightarrow$
$(1{,}200)/(-400) = -3 = (-c)/(1 - c) \Rightarrow -3(1 - c) = -c \Rightarrow c = 3/4$
==> mps = 1 - c = 1/4 = **0.25**.

c. $\Delta Y = \Delta C + \Delta NX = -800 + (-200) = -1{,}000$
==> $c = (\Delta C)/(\Delta Y) = (-800)/(-1{,}000) = .8 \Rightarrow$ multiplier = $\alpha = 1/(1 - c) = 1/(.2) = \mathbf{5}$

12. Explain why income taxation, the Social Security system, and unemployment insurance are considered automatic stabilizers.

Income taxes, unemployment benefits, and the Social Security system are often called automatic stabilizers because they reduce the amount by which output changes as a result of a change in aggregate demand. These stabilizers are a part of the structure of the economy and therefore work without any actual government intervention. For example, when output declines and unemployment increases. If we had no unemployment insurance, people out of work would not receive any disposable income and then consumption would drop significantly. But since unemployed workers get unemployment compensation, consumption will not decrease as much. Therefore, aggregate demand may not be reduced by as much as it would have without these automatic stabilizers.

13. Assume a simple model of the expenditure sector with a positive income tax rate (t). Show mathematically how an increase in lump sum taxes (TA_o) would affect the budget surplus.

From $BS = TA - G - TR = tY + TA_o - G - TR$

$\Rightarrow \Delta BS = t(\Delta Y) + \Delta TA_o = t(\text{mult.})(-c)(\Delta TA_o) + \Delta TA_o$
$= t[1/(1 - c + ct)](-c)(\Delta TA_o) + \Delta TA_o = ([-(ct) + 1 - c + (ct)]/[1 - c + (ct)])(\Delta TA_o)$
$= (1 - c)/[1 - c + (ct)])(\Delta TA_o) > 0$, since $c < 1$

In other words, a lump sum tax increase would increase the budget surplus.

14. True or false? Why?

"A tax cut will increase national income and will therefore always increase the budget surplus."

False. Although a tax cut raises national income, not all of the increase in income is spent, nor is it completely taxed away. Income tax revenues fall and the budget deficit rises. Assume the following model of the expenditure sector:

$Sp = C + I + G + NX$ $\quad I = I_o$
$C = C_o + cYD$ $\quad G = G_o$
$YD = Y - TA + TR$ $\quad NX = NX_o$
$TA = TA_o + tY$ $\quad BS = TA - G - TR$
$TR = TR_o$

From $Y = Sp \Rightarrow Y = C_o + c(Y - TA_o - tY + TR_o) + I_o + G_o + NX_o \Rightarrow$
$Y = C_o - cTA_o + cTR_o + I_o + G_o + NX_o + c(1 - t)Y = A_o + c'Y \Rightarrow$
$Y = [1/(1 - c')]A_o$ with $c' = c(1 - t)$

Thus $\Delta Y = [1/(1 - c')][(-c)(\Delta TA_o)]$

and $\Delta BS = t(\Delta Y) + (\Delta TA_o) = \{[t(-c)]/(1 - c') + 1\}(\Delta TA_o) ==>$

$= \{[-(ct) + 1 - c + (ct)]/[1 - c + (ct)]\}(\Delta TA_o) = \{(1 - c)/[1 - c + (ct)]\}(\Delta TA_o) > 0$ if $\Delta TA > 0$.

Therefore, if taxes fall, that is, if $\Delta TA < 0$, the budget surplus decreases.

15. Assume a simple model of the expenditure sector with a positive income tax rate (t). Show mathematically how a decrease in autonomous investment (I_o) would affect the budget surplus.

A decrease in autonomous investment (I_o) will have a multiplier effect and will therefore decrease national income and tax revenue. The budget surplus will decrease as shown below:

$\Delta BS = t(\Delta Y) = t\alpha(\Delta I_o) < 0$

16. "An increase in government purchases will always pay for itself, as it raises national income and hence the government's tax revenues." Comment on this statement.

An increase in government purchases will increase the budget deficit. If we assume a model of the expenditure sector with income taxes, then the multiplier equals $[1/(1 - c')]$ with $c' = c (1- t)$. The change in the budget surplus that arises from a change in government purchases can be calculated as

$\Delta BS = t(\Delta Y) - \Delta G = t[1/(1 - c')](\Delta G) - \Delta G = \{[t - 1 + c - (ct)]/[1 - c + (ct)]\}(\Delta G)$

$= - \{[(1 - c)(1 - t)]/(1 - c + (ct))\}(\Delta G) < 0$, sine $\Delta G > 0$.

Therefore, if government purchases are increased, the budget surplus will decrease.

17. Is the size of the actual budget surplus always a good measure for determining fiscal policy? What about the size of the full-employment budget surplus?

The actual budget surplus has a cyclical and a structural component. The cyclical component of the budget surplus changes with changes in the level of income whether or not any fiscal policy measure has been implemented. This implies that the actual budget surplus also changes with changes in income and is therefore not a very good measure for assessing fiscal policy. The structural (full-employment) budget surplus is calculated under the assumption that the economy is at full-employment. It therefore changes only with a change in fiscal policy and is a much better measure for fiscal policy than the actual budget surplus. One should keep in mind, however, that the balanced budget theorem implies that the government can stimulate national income by an equivalent and simultaneous increase in taxes and government purchases, thereby affecting the actual or the full-employment budget surplus.

18. Assume a model of the expenditure sector with income taxes, in which people who pay taxes, have a higher marginal propensity to consume than people who receive government transfers, and the consumption function is of the following form: $C = C_o + c(Y - TA) + dTR$, with $c < d$.

(a) What will happen to the equilibrium level of income and the budget surplus if government purchases are reduced by the same lump sum amount as taxes?

(b) What will happen to the equilibrium level of income and the budget surplus if government transfers are reduced by the same lump sum amount as taxes?

a. Assume that $\Delta TA_o = \Delta G = - 100 ==>$

$\Delta Y = [(-c)/(1 - c')(\Delta TA_o) + [1/(1 - c')](\Delta G) = [(1 - c)/(1 - c')](-100) < 0$ $\quad c' = c(1 - t)$

National income would decrease.

$\Delta BS = t(\Delta Y) + \Delta TA_o - \Delta G = t(\Delta Y) < 0$

The budget surplus would decrease by the loss in income tax revenue.

b. Assume that $\Delta TA_o = \Delta TR_o = - 100 ==>$

$\Delta Y = [(-c)/(1 - c')](\Delta TA_o) + [d/(1 - c')](\Delta TR_o) = [(d - c)/(1 - c')](-100) < 0$ $\quad c' = c(1 - t)$

National income would increase.

$\Delta BS = t(\Delta Y) + \Delta TA_o - \Delta TR_o = t(\Delta Y) < 0$

The budget surplus would decrease.

19. True or false? Why?

"The higher the marginal propensity to import, the lower the size of the multiplier."

True. Imports represent a leakage out of the income flow. An increase in autonomous spending will raise income and we will see the usual multiplier effect. However, if imports are positively related to income, this effect is reduced since higher imports reduce the level of domestic demand.

Closed Economy Model	Open Economy Model
$Sp = C + I + G$	$Sp = C + I + G + NX$
$C = C_o + cY$	$C = C_o + cY$
$G = G_o$	$G = G_o$
$I = I_o$	$I = I_o$
	$NX = NX_o - mY$
with $m > 0$	
	From $Y = Sp$ ==>
$Y = (C_o + I_o + G_o) + cY$	$Y = (C_o + I_o + G_o + NX_o) + (c - m)Y$
$Y = A_o + cY$	$Y = A_o + (c - m)Y$
$Y = [1/(1 - c)]A_o$	$Y = [1/(1 - c + m)]A_o$
	Therefore the multiplier is defined as
$[1/(1 - c)]$	$[1/(1 - c + m)]$

Clearly the open economy multiplier falls short of the closed economy multiplier. This is because leakages reduce demand. If income taxes were included in these models, they too would reduce the multipliers, as income taxes represent another leakage from the income flow.