The problems below are primarily intended for the B-level course in macroeconomics.

NOTE: Some questions on economic growth are harder and are only intended for the economics growth students.

Extra credit question: Below the B-level students find one problem for extra credit. The economic growth students find 2 problems that give extra credit if handed in.

Topics: Based on chapters in the textbook by Mankiw

1. Introduction
2. National income accounting
3. Aggregate supply: Factor markets
6. The labor market
Appendix 8. Growth accounting ("Tillväxtbokföring")
4. Money and inflation, excluding appendix. Skim chapter 19
3. The Keynesian model for a closed economy in the long run = The classical model for a closed economy
5. The Keynesian model for a small open economy in the long run = The classical model for a small open economy
9. Introduction to the Keynesian model in the short and long run (for a closed economy)
10.-11. The Keynesian model for a closed economy with a horizontal SRAS-curve
12. The Keynesian model for a small open economy with a horizontal SRAS-curve. Focus on floating exchange rates. Fixed exchange rates not included in the course.
13. The Keynesian model in the short and long run with a positively-sloped SRAS-curve
15. Government debt
16. EMU
17. Consumption
18. Investment Not included in course.

Endogenous labor supply. Not relevant for B-macroeconomics, but relevant for Economics growth students.

8. More questions on economic growth intended for economics growth students.
1. INTRODUCTION
Problem 1.3: Use the market model of supply and demand to explain how a fall in the price of frozen yogurt would affect the price of ice cream and the quantity of ice cream sold. In your explanation, identify the exogenous and endogenous variables.

Problem 1.4: Regarding the assumption of sticky prices in macroeconomics in the short run: How often does the price you pay for a haircut change?

2 NATIONAL INCOME ACCOUNTING
In Swedish: Nationalräkenskaper
Problem 2.1: Fill in all numbers where there now are question marks (?) in the table.

<table>
<thead>
<tr>
<th>Private consumption (C)</th>
<th>Privat konsumtion (C)</th>
<th>?</th>
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</thead>
<tbody>
<tr>
<td>Government purchases=</td>
<td>Offentlig konsumtion och offentliga investeringar (G)</td>
<td>300</td>
</tr>
<tr>
<td>government consumption and government investment(G)</td>
<td></td>
<td></td>
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<tr>
<td>Private investment (I)</td>
<td>Privata investeringar, Inklusive lagerinvesteringar (I)</td>
<td>150</td>
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<tr>
<td>Trade balance (NX)</td>
<td>Handelsbalansen (NX)</td>
<td>400</td>
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<tr>
<td>Labor income inclusive of income taxes and social security contributions</td>
<td>Arbetskraftskostnader inklusive sociala avgifter</td>
<td>900</td>
</tr>
<tr>
<td>Capital income</td>
<td>Kapitalinkomster</td>
<td>400</td>
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<tr>
<td>Depreciation of capital</td>
<td>Kapitalförslitning</td>
<td>100</td>
</tr>
<tr>
<td>Indirect taxes (VAT etc.)</td>
<td>Indirekta skatter, t ex moms</td>
<td>200</td>
</tr>
<tr>
<td>Net factor incomes from abroad (NFI)</td>
<td>Faktorinkomster från utlandet, netto (NFI)</td>
<td>50</td>
</tr>
<tr>
<td>Net transfers from abroad (NFTr)</td>
<td>Transfereringar från utlandet, netto (NFTr)</td>
<td>0</td>
</tr>
<tr>
<td>Government taxes (including indirect taxes)</td>
<td>Skatter, inklusive moms</td>
<td>350</td>
</tr>
<tr>
<td>Current Account Balance</td>
<td>Bytesbalansen</td>
<td>?</td>
</tr>
<tr>
<td>Gross Domestic Product(GDP)</td>
<td>Bruttonationalprodukten till Marknadspris (BNP)</td>
<td>?</td>
</tr>
<tr>
<td>Gross National Product(GNP)</td>
<td>Bruttonationalinkomst till Marknadspris (BNI)</td>
<td>?</td>
</tr>
<tr>
<td>National saving</td>
<td>Nationellt finansiellt sparande</td>
<td>?</td>
</tr>
<tr>
<td>Public saving</td>
<td>Offentligt finansiellt sparande</td>
<td>?</td>
</tr>
<tr>
<td>Private saving</td>
<td>Privat finansiellt sparande</td>
<td>?</td>
</tr>
</tbody>
</table>

NOTE: For a country and for the private and public sector: SAVING equals income minus consumption.

Problem 2.2: A farmer grows a bushel of wheat and sells it to a miller for 1 dollar. The miller turns the wheat into flour and then sells the flour to a baker for 3 dollars. The baker uses the flour to make bread and sells the bread to an engineer for 6 dollars. The engineer eats the bread. What is the value added by each person?

Problem 2.3: Suppose a woman marries her butler. After they are married, her husband continues to wait on her as before, and she continues to support him as before (but as a husband rather than as an employee): How does marriage affect GDP? How should it affect GDP?
Problem 2.4: Place each of the following transactions in one of the four components of expenditures: consumption, investment, government purchases, and net exports.
4a. Boeing sells an airplane to the Air Force.
4b. Boeing sells an airplane to American Airlines.
4c. Boeing sells an airplane to Air France.
4d. Boeing sells an airline to a private person.
4e. Boeing builds an airplane to be sold next year.

Problem 2.6: Consider an economy that produces and consumes bread and automobiles. In the following table are data for two different years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Price of an automobile</th>
<th>Price of a loaf of bread</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>USD 50,000</td>
<td>USD 10</td>
</tr>
<tr>
<td>2010</td>
<td>USD 60,000</td>
<td>USD 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of automobiles produced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of loaves of bread produced</td>
</tr>
</tbody>
</table>

Problem 2.7: Abby consumes only apples. In year 1, red apples cost one dollar each, green apples cost two dollars each, and Abby buys 10 red apples. In year 2, red apples cost two dollars, green apples cost one dollar, and Abby buys 10 green apples.

2.7a. Compute a consumer price index for apples for each year. Assume that year 1 is the base year in which the consumer basket is fixed. How does your index change from year 1 to year 2?
2.7b. Compute Abby’s nominal spending on apples in each year. How does it change from year 1 to year 2?
2.7c. Using year 1 as the base year, compute Abby’s real spending on apples in each year. How does it change from year 1 to year 2?
2.7d. Defining the implicit price deflator as nominal spending divided by real spending, compute the deflator for each year. How does the deflator change from year 1 to year 2?
2.7e. Suppose that Abby is equally happy eating red or green apples. How much has the true cost of living increased for Abby? Compare this answer to your answers to parts (a) and (d). What does this example tell you about Laspeyres and Paasche price indices?

Problem 2.8: Consider how each of the following events is likely to affect real GDP. Do you think the change in real GDP reflects a similar change in economic well-being?
2.8a. A hurricane in Florida forces Disney World to shut down for a month.
2.8b. The discovery of a new, easy-to-grow strain of wheat increases farm harvests.
2.8c. Increased hostility between unions and management sparks a rash of strikes.
2.8d. Firms throughout the economy experience falling demand, causing them to lay off workers.
2.8e. Congress passes new environmental laws that prohibit firms from using production methods that emit large quantities of pollution.
2.8f. More high-school students drop out of school to take jobs mowing lawns.
2.8g. Fathers around the country reduce their work-weeks to spend more time with their children.
3. THE SUPPLY SIDE OF THE ECONOMY: AGGREGATE PRODUCTION AND FACTOR MARKETS

Problem 3.1: Use the neoclassical theory of distribution to predict the impact on the real wage and the real rental price of capital of each of the following events:

A. A wave of immigration increases the labor force.
B. An earthquake destroys some of the capital stock.
C. A technological advance improves the production function.

Problem 3.2: If a 10-percent increase in both capital and labor causes output to increase by less than 10 percent, the production function is said to exhibit decreasing returns to scale. If it causes output to increase by more than 10 percent, the production function is said to exhibit increasing returns to scale. Why might a production function exhibit increasing or decreasing returns to scale?

Problem 3.3: Suppose that an economy’s production function is Cobb-Douglas with parameter $\alpha=0.3$. One way to solve B.-D., assume numerical values, e.g.: Assume $A=1$, $K=1$, $L_0=1$ and $L_1=1.1$.

3.3A. What fractions of income do capital and labor receive?
3.3B. Suppose that immigration raises the labor force by 10 percent. What happens to total output (in percent)? The rental price of capital? The real wage?
One way to solve B., assume $A=1$, $K=1$, $L_0=1$ and $L_1=1.1$.
3.3C. Suppose that a gift of capital from abroad raises the capital stock by 10 percent. What happens to total output (in percent)? The rental price of capital? The real wage?
3.3D. Suppose that a technological advance raises the value of the parameter $A$ by 10 percent. What happens to total output (in percent)? The rental price of capital? The real wage?

Problem 3.4.: Empirically the trend in the real wage closely tracks the trend in labor productivity. Explain why?

Problem 3.5. A. Over the past century, the productivity of farmers has risen substantially because of technological progress. According to the neoclassical theory, what should have happened to their real wage? B. In what units is the real wage in part (a) measured? C. Over the same period, the productivity of barbers has remained constant. What should have happened to their real wage? D. In what units is the real wage in part (c) measured? E. Suppose workers can move freely between farmers and being barbers. What does this mobility imply for the wages of farmers and barbers? F. What do your previous answers imply for the price of haircuts relative to the price of food? G. Who benefits from technological progress in farming – farmers or barbers?

Problem 3.6.: (Harder) Consider a Cobb-Douglas production function with three inputs. $K$ is capital (the number of machines), $L$ is labor (the number of workers), and $H$ is human capital (the number of college degrees among the workers). The production function is:

$$Y = K^{1/3} \cdot L^{1/3} \cdot H^{1/3}$$

Problem 3.6A. Derive an expression for the marginal product of labor. How does an increase in the amount of human capital affect the marginal product of labor?
Problem 3.6B. Derive an expression for the marginal product of human capital. How does an increase in the amount of human capital affect the marginal product of human capital?
Problem 3.7C. What is the income share paid to labor? What is the income share paid to human capital? In the national income accounts of this economy, what share of total income
do you think workers would appear to receive? (Hint: Consider where the return to human capital shows up.)

Problem 3.7D. An unskilled worker earns the marginal product of labor, whereas a skilled worker earns the marginal product of labor plus the marginal product of human capital. Using your answers to (a) and (b), find the ratio of the skilled wage to the unskilled wage. How does an increase in the amount of human capital affect this ratio? Explain.

Problem 3.7E. Some people advocate government funding of college scholarships as a way of creating a more egalitarian society. Others argue that scholarships help only those who are able to go to college. Do your answers to the preceding questions shed light on this debate?

6. THE LABOR MARKET

Problem 6.1: Suppose that students look for part-time jobs. On average it takes 2 weeks to find a part-time job, and the part-time job lasts on average 12 weeks.
A. Calculate the rate of job finding per week and the rate of job separation per week.
B. What is the natural rate of unemployment for this population of students?

Problem 6.3: The residents of a certain dormitory have collected the following data: People who live in the dorm can be classified as either involved in a relationship or uninvolved. Among the involved people, 10 percent experience a breakup of their relationship every month. Among uninvolved people, 5 percent will enter into a relationship every month. What is the steady-state (“equilibrium”) fraction of residents who are uninvolved?

Problem 6.4: Suppose that Congress passes legislation making it more difficult for firms to fire workers. If this legislation reduces the rate of job separation without affecting the rate of job finding, how would the natural rate of unemployment change? Do you think that it is plausible that the legislation would not affect the rate of job finding? Why or why not?

Problem 6.5: Consider an economy with the following Cobb-Douglas production function:
\[ Y = K^{1/3} \cdot L^{2/3}. \] The economy has 1000 units of capital and a labor force of 1000 workers.

A. Derive the equation describing the labor demand in this economy as a function of the real wage and the capital stock. B. If the real wage can adjust to equilibrate labor supply and labor demand, what is the real wage? In this equilibrium, what is employment, output, and the total amount earned by workers? C. Assume that a minimum wage of 1 dollar is imposed by Congress. What happens to employment, output, and the total amount earned by workers? D. Did the minimum wage help the working class in this example?

Problem 6.6: Suppose that a country experiences a reduction in productivity (A);
A. What happens to the labor demand curve?
B. What is the effect on employment, unemployment and the real wage if we assume perfect competition? Assume that the labor supply curve is vertical.
C. How would this change in productivity affect employment if unions prevent the real wage from falling?
APPENDIX OF CHAPTER 8:
GROWTH ACCOUNTING ("TILLVÄXTBOKFÖRING") AND GROWTH RATES

Problem 8.1: In an economy which is characterized by perfect competition in the goods and labor market, the owners of capital get two-thirds of national income, and the workers receive one-third. Assume a Cobb-Douglas aggregate production function.

Problem 8.1A: The men stay at home in this economy, while the women work in factories. If some of the men started working outside the home so that the labor force increased by 5 percent, what would happen to the measured output of the economy? Does labor productivity (output per worker) increase, decrease or stay the same? Does total factor productivity (A) increase, decrease, or stay the same? One way to solve exercise., assume A=1, K=1, L0=1 and L1=1.05.

Problem 8.1B: In year 1, the capital stock was 6, the labor input was 3, and output was 12. In year 2, the capital stock was 7, the labor input was 4, and output was 14. What happened to total factor productivity between the years?

Problem 8.3: Assume an economy which is characterized by perfect competition in the goods and labor market, in which the owners of capital get one-third of national income, and the workers receive two-thirds. Assume a Cobb-Douglas aggregate production function. Assume that total output and total capital stock grow at 3.6 percent per year, and that labor input grows by one percent per year. Use the growth-accounting equation to divide output growth into three sources – capital, labor, and total factor productivity – how much of output growth would you attribute to each source?

Problem 8.4. If GDP per capita in Sweden (in 1995 prices) in 1995 and 2000 were 194 and 222 thousands of kronor, what was the average annual rate of economic growth during this 5-year period?

Problem 8.5. If a variable during a 30-year period increases by 54 percent, what average annual growth rate does this correspond to?

Problem 8.6. If the growth rate of GDP per capita was 2 percent between 1960 and 1990, and the population growth rate was 3 percent during the same period, what was the growth rate of GDP during this period?

Problem 8.7: Assume that GDP per capita in Sweden and Zambia in 2002 were 16000 and 800 USD, respectively, and that the growth rate of GDP per capita in Sweden and Zambia is 1 and 7 percent, respectively.
   a) How does the absolute difference between the 2 countries develop over time? That is, GDP per capita in Sweden – GDP per capita in Zambia.
   b) How does the relative difference develop over time? That is, GDP per capita in Sweden/GDP per capita in Zambia.
   USE EXCEL to answer these questions.

Problem 8.8: If your wage is 100 kronor and the growth rate is 5 percent, how many years does it take for your wage to double?
7. ECONOMIC GROWTH THEORY: THE SOLOW MODEL

Problem 7.00: Show in the Solow-diagram and explain in words:
A. The effect of an increased saving rate on the steady-state levels of production per worker ($Y/L$), capital per worker ($K/L$), and the real wage ($W/P$).
B. The effect of a lower population growth rate on the steady-state levels of production per worker ($Y/L$), capital per worker ($K/L$), and the real wage ($W/P$).
C. The effect of a better technology on the steady-state levels of production per worker ($Y/L$), capital per worker ($K/L$), and the real wage ($W/P$).

Problem 7.01A. In the long-run equilibrium, assume that the long-run population growth rate is 2 percent (that is, $n=0.02$), and the long-run growth rate of $A$ is 0 percent (that is, $g=0$), calculate the long-run equilibrium growth rate of $Y$, ($Y/L$), $K$, ($K/L$), and the real wage ($W/P$).

Problem 7.01B. In the long-run equilibrium, assume that the long-run population growth rate is 2 percent (that is, $n=0.02$), and the long-run growth rate of $A$ is 2 percent (that is, $g=0.02$), calculate the long-run equilibrium growth rate of $Y$, ($Y/L$), $K$, ($K/L$), and the real wage ($W/P$).

Voluntary exercise to be handed for extra credit: 2 points on the exam.
Deadline: XXXXX. Instruction: Please do the following exercise on economic growth in EXCEL. Your memo should be written in WORD; that is, tables should be written in WORD and figures from Excel should be pasted into a word document. Please do Attach your excel-sheet where all your calculation are performed. Send your memo + your EXCEL-sheet to joakim.persson@kau.se. To perform exercise read my handouts (and Mankiw). The names of the authors of the memo should be written in the memo.

Excel 1. Transition to equilibrium
1a. Fill out the table below. You need probably to make 2 tables to make room for all the numbers. 1b. Plot $y$, $K/L$, the real wage, and the real return to capital against time in diagrams. Plot $ln y$ against time in a diagram.
1c. Plot the growth rate of $y$ against $y$ in one diagram.

Assume starting value: $k(year=0)=2.00$.
Assume also: $A=1$, $s=0.25$, $\delta = 0.1$, $\alpha =0.5$, and $n=0.02$. $N(year=0)=100$

<table>
<thead>
<tr>
<th>Year</th>
<th>K</th>
<th>$y = k^\alpha$</th>
<th>$c$</th>
<th>$i$</th>
<th>$\delta \cdot k$</th>
<th>$\Delta \cdot k$</th>
<th>$\Delta \cdot y$</th>
<th>$\Delta \cdot y$</th>
<th>$\Delta \cdot y$</th>
<th>$\Delta \cdot y$</th>
<th>Real wage</th>
<th>$r$</th>
<th>$Y$</th>
<th>$K$</th>
<th>$N$</th>
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<tbody>
<tr>
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Note: $r$ is real return to capital. $r=$MPK-depreciation rate. Briefly comment your results.

2A. Assume the parameter values above, and that the economy is in its steady state in period 0. Assume that in period 1 the parameter $A$ increases to 2. Make a new table showing the transition to the new steady state. 2b. Plot $ln y$ against time. 2c. Plot the growth rate of $y$ against $y$ in one diagram. Briefly comment your results.
3. What happens if \( s \) increases? Assume that the economy in period 0 is in its equilibrium (described by the parameter values in exercise 1), and that \( s \) increases to 0.35.

4. Assume that the economy in period 0 is in its equilibrium (described by the parameter values in exercise 1), and that \( n \) increases to 0.04. Make a new table showing the transition to the new steady state. Compare the old equilibrium with the new equilibrium with respect to \( Y/L, K/L, \) the real wage, the real return to capital (\( r \)), \( K \), and \( Y \).

**Quantitative questions ch. 7 of Mankiw, which are relevant for B-macroeconomics, and economic growth course:**

**Problem 7.1:** Country A and B has the production function:
\[
Y = F(K, L) = K^{0.5} \cdot L^{0.5}
\]
A. Does this production function have constant returns to scale?
B. What is the per-worker production function, \( Y/L = f(K/L) \)
C. Assume that neither country experiences population growth or technological progress and that 5 percent of capital depreciates each year. Assume further that country A saves 10 percent of output each year, and country B saves 20 percent of output each year. Find the steady state level of capital per worker, the steady-state level of income per worker and consumption per worker.
D. Suppose that both countries start off with a capital stock per worker of 2. What are the levels of income per worker and consumption per worker? Remembering that the change in the capital stock is gross investment minus depreciation, calculate capital stock per worker, income per worker, and consumption per worker over time. How many years will it be before consumption per worker in Country B is higher than the level of consumption per worker in country A.

**Problem 7.2:**
In the discussion of German and Japanese postwar growth, the text describes what happens when part of the capital stock is destroyed in a war. By contrast, suppose that a war does not affect the capital stock, but that casualties reduce the labor force.
A. What is the immediate impact on total output and on output per person?
B. Assuming that the saving rate is unchanged and that the economy was in a steady state before the war, what happens subsequently to output per worker in the postwar economy? Is the growth rate of output per worker after the war smaller or greater than normal?

**Problem 7.3:** Consider an economy described by the production function:
\[
Y = F(K, L) = K^{0.3} \cdot L^{0.7}
\]
A. What is the per-worker production function?
B. Assuming no population growth or technological progress, find the steady-state capital stock per worker, output per worker, and consumption per worker as a function of the saving rate and the depreciation rate.
C. Assume that the depreciation rate is 10 percent per year. Make a table showing steady-state capital per worker, output per worker, and consumption per worker for saving rates of 0 percent, 10 percent, 20 percent, and 30 percent and so on. What saving rate maximizes output per worker? What saving rate maximizes consumption per worker?
D. Use calculus to find the marginal product of capital. Add to your table the marginal product of capital net of depreciation for each of the saving rates.
Problem 7.4. “Devoting a larger share of national output to investment would help restore rapid productivity growth and rising living standards”. Do you agree with this claim? Explain.

Problem 7.5: (somewhat hard) One view of the consumption function is that workers have high propensities to consume and capitalists have low propensities to consume. To explore the implications of this view, suppose that an economy consumes all wage income and saves all capital income. Show that if the factors of production earn their marginal product, this economy reaches the Golden rule level of capital. (Hint: Begin with the identity that saving equals investment. Then use the steady-state condition that investment is just enough to keep up with depreciation and population growth, and the fact that saving equals capital income in this economy.)

Problem 7.6: Many demographers predict that the US will have zero population growth in the 21st century, in contrast to an average population growth of about 1 percent per year in the 20th century. Use the Solow model to forecast the effect of this slowdown in population growth on the growth of total output and the growth of output per person. Consider the effects both in the steady state and in the transition between steady states.

Problem 7.9: Empirically, as an indicator of the saving rate is investment/GDP. In a closed economy, saving equals investment. And in an open economy saving may be close to investment. No question here.

Problem 7.10: Assume the Solow growth model with population growth and with no technological progress: Derive steady-state expressions for capital per worker, output per worker, the real wage and the real return to capital.

\[ Y = F(K, L) = A \cdot K^{\alpha} \cdot L^{1-\alpha} \]

As functions of the exogenous variables: What happens to the real wage and the real return to capital if the saving rate increases?
4. MONEY AND INFLATION

Problem 4.1: What are the 3 functions of money? Which of the functions do the following items satisfy? A. A credit card. B. A painting by Rembrandt. C. A subway token.

Problem 4.2: In the country of Wiknam, the velocity of money is constant. Real GDP grows by 5 percent per year, the money stock grows by 14 percent per year, and the nominal interest rate is 11 percent. What is the real interest rate?

Problem 4.5: During the World War II, both Germany and England had plans for a paper weapon: they each printed the other’s currency, with the intention of dropping large quantities by airplane. Why might this have been an effective weapon?

Problem 4.6: What happens to a debt when there is high inflation? Make a distinction between expected and unexpected inflation.

4. MONEY AND INFLATION

Answer: Problem 4.1:
A. A credit card is a medium of exchange.
B. A painting is a store of value.
C. A subway token, within the subway system, satisfies all 3 functions of money, which are store of value, unit of account, and medium of exchange.

Answer: Problem 4.2:
Use the quantity equation to calculate the inflation rate. Using this rate of inflation and the Fischer equation yields a real interest rate of 2 percent.

Answer: Problem 4.5:
Paper weapon might create inflation, and even hyperinflation.

Answer: Problem 4.6:
If the debt is in nominal terms (which is the usual case; that is, in dollars), inflation reduces the real value of. Inflation has to be unexpected. If high inflation is expected, banks demand a higher (fixed) nominal interest rate. So if you are debtor and have a fixed nominal interest rate and the actual inflation rate is higher than the expected one, you are happy. This is because your actual real interest rate on your loan becomes lower than the expected real interest rate. If you have a floating interest rate, a higher actual inflation rate should not matter as the nominal interest rate tends to adjust.

Problem 4.7:
Some economic historians have noted that during the period of the gold standard (which was a period during which money and gold are in a fixed ratio), gold discoveries were most likely to occur after a long deflation.

Answer: Problem 4.7:
A deflation is a fall in the general price level, which is the same as a rise in the value of money. Under a gold standard, a rise in the value of money is a rise in the value of gold because money and gold are in a fixed ratio. Therefore, after a deflation, an ounce of gold buys more goods and services. This creates an incentive to look for new gold deposits and, thus, more gold is found after a deflation.
Problem 3.7: The government raises taxes by 100 billions USD. If the marginal propensity to consume is 0.6, what happens to public, private, and national saving and to investment? Do they rise or fall? By what amounts?

Problem 3.8: Suppose that an increase in consumer confidence raises consumers’ expectations about their future income and thus increases the amount they want to consume today. This might be interpreted as an upward shift in the consumption function. How does this shift affect investment and the interest rate.

Problem 3.9: Consider an economy described by the following equations: $Y = C + I + G$, $Y = 5000$, $G = 1000$, $T = 1000$, $C = 250 + 0.75(Y - T)$, $I = 1000 - 50r$. A. In this economy, compute private saving, public saving, and national saving. B. Find the equilibrium interest rate. C. Now suppose that $G$ rises to 1250. Compute private saving, public saving, and national saving. D. Find the new equilibrium interest rate. E. Now suppose $T$ decreases to 750 (and $G = 1000$). Compute private, public and national saving, and find the new equilibrium interest rate.

Problem 3.10: Suppose that the government increases taxes and government purchases by equal amounts. What happens to the interest rate and investment in response to this balanced budget change? Does your answer depend on the marginal propensity to consume?

Problem 3.11: When the government subsidizes investment, such as with an investment tax credit, the subsidy often applies to only some types of investment. Suppose that there are two types of investment in the economy: business investment and residential investment. And suppose that the government institutes an investment tax credit only for business investment. A. How does this policy affect the demand curve for business investment? The demand curve for residential investment. B. Draw the economy’s supply and demand for loanable funds. How does this policy affect the supply and demand for loanable funds? What happens to the equilibrium interest rate? C. Compare the old and the new equilibrium. How does this policy affect the total quantity of investment? The quantity of business investment? The quantity of residential investment?

Problem 3.12: If consumption depended on the interest rate, how would that affect the conclusions reached in this chapter about the effects of fiscal policy?
5. THE CLASSICAL MODEL FOR THE SMALL OPEN ECONOMY= THE KEYNESIAN MODEL FOR THE SMALL OPEN ECONOMY IN THE LONG RUN

Problem 5.1: Use the model of the small open economy to predict what would happen to the trade balance, the real exchange rate, and the nominal exchange rate in response to each of the following events: A. A fall in consumer confidence about the future induces consumers to spend less and save more. B. The introduction of a stylish line of Toyotas makes some consumers prefer foreign cars over domestic cars. C. The introduction of automatic teller machines reduces the demand for money.

Problem 5.2: Consider an economy described by the following equations:
\[
Y = C + I + G + NX, \quad Y = 5000, \quad G = 1000, \quad T = 1000, \quad C = 250 + 0.75(Y - T), \quad I = 1000 - 50r, \\
NX = 500 - 500\varepsilon.
\] A. In this economy, solve for national saving, investment, the trade balance, and the equilibrium exchange rate. B. Suppose now that G rises to 1250. Solve for national saving, investment, the trade balance, and the equilibrium exchange rate. Explain.

Problem 5.3: The country of Leverett is a small open economy. Suddenly, a change in world fashions makes the exports of Leverett unpopular. A. What happens in leveret to saving, investment, net exports, the interest rate, and the exchange rate. B. The citizens of leveret like to travel abroad. How will this change in the exchange rate affect them? C. The fiscal policy makers of Leverett want to adjust taxes to maintain the exchange rate at its previous level. What should they do? If they do this, what are the overall effects on saving, investment, net exports, and the interest rate?

Problem 5.5: What will happen to the trade balance and the real exchange rate of a small open economy when government purchases increase, such as during a war? Does your answer depend on whether this is a local war or a world war?

Problem 5.6: A case study in this chapter concludes that if poor nations offered better production efficiency and legal protections, the trade balance in rich nations would move towards a surplus. Let’s consider why this might be the case. A. If the world’s poor nations offer better production efficiency and legal protection, what would happen to the investment demand function in those countries? B. How would the change that you describe in A. affect the demand for loanable funds in world financial markets? C. How would the change you describe in B affect the world interest rate? D. How would the change in the world interest rate you describe in C affect the trade balance in rich countries?

Problem 5.7: The president is considering placing a tariff on the import of Japanese luxury cars. Discuss the economics and politics of such a policy. In particular, how would the policy affect the US trade deficit? How would it affect the exchange rate? Who would be hurt by such a policy? Who would benefit?

Problem 5.8: Suppose that some foreign countries begin to subsidize investment by instituting an investment tax credit. A. What happens to world investment demand as a function of the world interest rate? B. What happens to the world interest rate? C. What happens to investment in our small open economy? D. What happens to our trade balance? E. What happens to our real exchange rate?

Problem 5.9: Traveling in Mexico is much cheaper now than it was 10 years ago, says a friend. “Because ten years ago, a dollar bought 10 pesos; this year, a dollar buys 15 pesos. Is
your friend right or wrong? Given that total inflation over this period was 25 percent in the US and 100 percent in Mexico, has it become more or less expensive to travel in Mexico?

Problem 5.10: The nominal interest rate is 12 percent per year in Canada and 8 percent per year in the USA. Suppose that the real interest rate is the same in these two countries, and that purchasing-power parity holds. A. Use the Fischer equation (discussed in chapter 4.) what can you say about expected inflation in Canada and in the USA? B. What can you say about the expected change in the exchange rate between the Canadian dollar and the US dollar? C. A friend proposes a get-rich-quick scheme: borrow from a US bank at 8 percent, deposit the money in a Canadian bank at 12 percent, and make a 4 percent profit. What’s wrong with this scheme?

9. INTRODUCTION TO THE KEYNESIAN MODEL IN THE SHORT AND LONG RUND FOR THE CLOSED ECONOMY
We use the regular AD-curve: \( AD = C(Y-T)+I(real\ interest\ rate)+G \) to answer the questions. In other words, we use the AD-curve from Chapter 3.

Problem 10.5. Suppose that the money demand function is: \( \frac{M}{P} = Y - 100 \cdot r \), where \( r \) is the nominal interest rate=real interest rate in percent. Let \( Y=1000, \) and \( M=1000, \) and \( P=2. \) A. Graph the supply and demand for real money balances. B. What is the equilibrium interest rate? C. Assume that the price level is fixed. What happens to the equilibrium interest rate if the supply of money is raised from 1000 to 1200? D. If the central bank wishes to raise the interest rate to 7 percent, what nominal money supply \( (M) \) should it choose?

Problem 9.1 (modified): Suppose that banks start paying interest on current accounts so that holding money becomes more attractive. Recall that the money stock is the sum of currency and demand deposits, including current accounts. A. How is real money demand affected? What happens to the interest on interest-bearing government bonds? B. What happens to the velocity of money? C. If the central bank keeps the money supply constant, what will happen to output and prices in the short and in the long run? D. Should the central bank keep the central bank constant in response to this change in behavior of banks?

Problem 9.2: Suppose that the central bank reduces the nominal money supply by 5 percent. A. What happens to the aggregate demand curve? B. What happens to the level of output and the price level in the short run and in the long run? C. What happens to the real interest rate in the short run and in the long run? (Hint: Use the model of the real interest rate in chapter 3 to see what happens when output changes.)

Problem 9.3: Suppose that central bank A cares only about keeping the price level stable, and central bank B cares only about keeping output and employment at their natural levels. Explain how each central bank would respond to each of the following: A. An exogenous decrease in the velocity of money; that is, an increase in Real money demand at given levels of the interest rate and income. B. B. An exogenous increase in the price of oil.
10. THE SIMPLE KEYNESIAN MODEL FOR THE SHORT RUN FOR A CLOSED ECONOMY

1. Use the simple Keynesian Model to predict the impact of
   a. An increase in government purchases.
   b. An increase in taxes,
   c. An equal increase government purchases and taxes.

2. In the simple Keynesian model, assume that the consumption function is given by
   \[ C = 200 + 0.75 (Y - T). \]

   Planned investment is 100, government purchases and taxes are both 100.
   a. Graph planned expenditure as a function of income.
   b. What is the equilibrium level of income?
   c. If government purchases increase to 125, what is the new equilibrium income?
   d. What level of government purchases is needed to achieve an income of 1,600?

3. Although our basic version of the simple Keynesian model assumes that taxes are fixed amount, in many countries (including the United States) taxes depend on income. Let’s represent the tax system by writing tax revenue as
   \[ T = \bar{T} + t \cdot Y \]
   Where \( \bar{T} \) and \( t \) are parameters of the tax code. The parameter \( t \) is the marginal and proportional tax rate: if income rises by $1, taxes rise by \( t \times $1 \).
   a. How does this tax system change the way consumption responds to changes in GDP?
   b. In the simple Keynesian model, how does this tax system alter the government-purchases multiplier?

4. Consider the impact of an increase in thriftiness in the simple Keynesian model.
   Suppose the consumption function is
   \[ C = \bar{C} + c \cdot (Y - T) \]
   Where \( \bar{C} \) is a parameter called autonomous consumption and \( c \) is the marginal propensity to consume.
   a. What happens to equilibrium income when the society becomes more thrifty, as represented by a decline \( \bar{C} \)?
   b. What happens to equilibrium saving?
   c. Why do you suppose this result is called the paradox of thrift?
   d. Does this paradox arise in the classical model for a closed economy? Why or why not?
11. THE KEYNESIAN MODEL FOR THE SHORT RUN FOR A CLOSED ECONOMY with a horizontal SRAS-curve. (The IS-LM-model)

1. According to the Keynesian model in the short run for a closed economy (The IS-LM-model), what happens to the interest rate, income, consumption, and investment under the following circumstances?
   a. The central bank increases the money supply.
   b. The government increases government purchases.
   C. The government increases taxes
   d. The government increases government purchases and taxes by equal amounts.

2. Use the Keynesian model in the short run for a closed economy (The IS-LM-model) to predict the effects of each of the following shocks on income, the interest rate, consumption and investment. In each case, explain what the central bank should do to keep income at its initial level.
   a. After the invention of a new high-speed computer chip, many firms decide to upgrade their computer systems.
   b. A wave of credit-card frauds increases the frequency with which people make transactions in cash.
   c. A best-seller titled Retire Rich convinces the public to increase the percentage of their income devoted to saving.

3. Consider the economy of Hicksonia
   a. The consumption function is given by

   \[ C = 200 + 0.75 \cdot (Y - \bar{T}) \]

   The investment function is

   \[ I = 200 - 25 \cdot r \]

   Government purchases and taxes are both 100.

   The money demand function in Hicksonian is:

   \[ \left( \frac{M}{P} \right)^d = Y - 100 \cdot r \]

   The money supply M is 1000 and the price level P is 2.

   c. Find the equilibrium interest rate r and the equilibrium level of income Y.

   d. Suppose that government purchases are raised from 100 – 150. How much would Y increase if the real interest rate were constant? What are the new equilibrium interest rate and level of income?

   e. Suppose instead that the money supply is raised from 1,000 to 1,200. What are the new equilibrium interest rate and level of income?

   f. With the initial values for monetary and fiscal policy, suppose that the price level rises from 2 to 4. What happens? What are the new equilibrium interest rate and level of income?

   g. Derive and graph an equation for the aggregate demand curve. What happens to this aggregate demand curve if fiscal or monetary policy changes, as in parts (d) and (e)?
5. Suppose that the government wants to raise investment but keep output constant. In the IS-LM model, what mix of monetary and fiscal policy will achieve this goal? In the early 1980s, the U.S. government cut taxes and ran a budget deficit while the Fed pursued a tight monetary policy. What effect should this policy mix have?

6. Use the IS-LM model to describe the short-run and long-run effects of the following changes on national income, the interest rate, the price level, consumption, investment, and real money balances,
   a. An increase in the money supply.
   b. An increase in government purchases.
   c. An increase in taxes.

7. The Fed is considering two alternatives monetary policies:
   * holding the money supply constant and letting the interest rate adjust, or
   * adjusting the money supply to hold the interest rate constant.

In the IS-LM model, which policy will better stabilize output under the following conditions?
   a. All shocks to the economy arise from exogenous changes in the demands for goods and service.
   b. All shocks to the economy arise from exogenous changes in the demands for money.
12. THE KEYNESIAN MODEL FOR THE SHORT RUN FOR A SMALL OPEN ECONOMY with a horizontal SRAS-curve. (The Mundell-Fleming model) Student should focus on floating exchange rates.

1. Use the Mundell-Fleming model to predict what would happen to aggregate income, the exchange rate, and the trade balance under both floating and fixed exchange rates in response to each of the following shocks: A. A fall in consumer confidence about the future induces consumers to spend less and save more. B. The introduction of a stylish line of Toyotas makes some consumers prefer foreign cars over domestic cars. C. The introduction of automatic teller machines reduces the real demand for money.

2. A small open economy with a floating exchange rate is in recession with balanced trade. If policymakers want to reach full employment while maintaining balanced trade, what combination of monetary and fiscal policy should they choose?

3. The Mundell-Fleming model takes the world interest rate \( r^* \) as an exogenous variable. Let’s consider what happens when this variable changes? A. What might cause the world interest rate to rise? B. In the Mundell-Fleming model with a floating exchange rate, what happens to aggregate income, the exchange rate, and the trade balance when the world interest rate rises?

4. Business executives and policymakers are often concerned about the “competitiveness” of American industry (the ability of U.S. industries to sell their goods profitably in world markets). a. How would a change in the exchange rate affect competitiveness? b. Suppose you wanted to make domestic industries more competitive but did not want to alter aggregate income. According to the Mundell-Fleming model, what combination of monetary and fiscal policies should you pursue?

5. Suppose that higher income implies higher imports and thus lower net exports. That is, the net exports function is: \( NX=NX(e,Y) \). Examine the effects in a small open economy of a fiscal expansion on income and trade balance under a floating exchange rate.

6. Suppose that the price level relevant for money demand includes the price of imported goods and that the price of imported goods depends on the exchange rate. That is, the money market is described by \( M/P=L(r,Y) \) where \( P = \lambda \cdot P_d + (1-\lambda) \cdot P_f / e \). The parameter \( \lambda \) is the share of domestic goods in the price index \( P \). Assume that the price of domestic goods \( P_d \) and the price of foreign goods measured in foreign currency \( P_f \) are fixed. B. What is the effect of expansionary fiscal policy under floating exchange rates in this model? Explain. Contrast with the standard Mundell-Fleming model.
13. THE KEYNESIAN MODEL IN THE SHORT AND LONG RUN WITH A
POSITIVELY SLOPED SRAS-CURVE. THE AS/AD-model.

2. Consider the following changes in the sticky-wage model.
   a. Suppose that labor contracts specify that the nominal wage be fully indexed for
      inflation. That is, the nominal wage is to be adjusted to fully compensate for changes
      in the consumer price index. How does full indexation alter the aggregate supply curve
      in this model?
   b. Suppose now that indexation is only partial. That is, for every increase in the CPI, the
      nominal wage rises, but by a smaller percentage. How does partial indexation alter the
      aggregate supply curve in this model?

3. Suppose that an economy has the Philips curve
   \[ \pi = \pi_{-1} - 0.5(u - 0.06) \]
   a. What is the natural rate of unemployment?
   b. Graph the short-run and long-run relationships between inflation and unemployment.
   c. How much cyclical unemployment is necessary to reduce inflation by 5 percentage
      points? Using Okun’s law, compute the sacrifice ratio.
   d. Inflation is running at 10 percent. The fed (=central bank in the US) wants to reduce it
      to 5 percent. Give two scenarios that will achieve that goal.

4. According to the rational-expectations approach, if everyone believes that policymakers are
   committed to reducing inflation, the cost of reducing inflation—the sacrifice ratio—will be lower
   than if the public is sceptical about the policymakers’ intentions. Why might this be true?
   How might credibility be achieved?

5. Assume that people have rational expectations and that the economy is described by the
   sticky-wage or sticky-price model. Explain why each of the following propositions is true:
   a. Only unanticipated changes in the money supply affects real GDP. Changes in the
      money supply that were anticipated when wages and prices were set do not have any
      real effects.
   b. If the Fed chooses the money supply at the same time as people are setting wages and
      prices, so that everyone has the same information about the state of the economy, then
      monetary policy cannot be used systematically to stabilize output. Hence, a policy of
      keeping the money supply constant will have the same real effects as a policy of
      adjusting the money supply in response to the state of economy. (This is called the
      policy irrelevance proposition.)
   c. If the Fed sets the money supply well after people have set wages and prices, so the
      fed has collected more information about the state of economy, then monetary policy
      can be used systematically to stabilize output.
6. Suppose that an economy has the Phillips curve

\[ \pi = \pi_n - 0.5(u - u^n) \]

and that the natural rate of unemployment is given by an average of the past two years’ unemployment:

\[ u^n = 0.5(u_{-1} - u_{-2}) \]

a. Why might the natural rate of unemployment depend on recent unemployment (as is assumed in the preceding equation)?
b. Suppose that the Fed follows a policy to reduce permanently the inflation rate by 1 percentage point. What effect would that policy have on unemployment rate over time?
c. What is the sacrifice ratio in this economy? Explain.
d. What do these equations imply about the short-run and long-run tradeoffs between inflations and unemployment?

7. If higher taxes cause people to want to work less and lower taxes cause people to want to work more. Consider this in the AS/AD-model:
a. If this view is correct, how does a tax cut affect the natural rate of output?
b. How does a tax cut affect the aggregate demand curve? The LRAS- and SRAS-curves?
c. What is the short-run impact of a tax cut on output and the price level?
   How does your answer differ from the case without the labor-supply effect?
d. What is the long-run impact of a tax cut on output and the price level?
   How does your answer differ from the case without the labor-supply effect?

14. STABILIZATION POLICIES

1. Suppose that the trade off between unemployment and inflations is determined by the Phillips curve:

\[ u = u^n - \alpha(\pi - \pi^e) \]

Where \( u \) denotes the unemployment rate, \( u^n \) the natural rate, \( \pi \) the rate of inflation, and \( \pi^e \) the expected rate of inflation. In addition, suppose that the Democratic party always follows a policy of high money growth and the Republican party always follows a policy of low money growth. What “political business cycle” pattern of inflation and unemployment would you predict under the following conditions?
   a. Every four years, one of the parties takes control based on a random flip of a coin.  
      [Hint: What will expected inflation be prior to the election?]
   b. The two parties take turns.

2. When cities pass laws limiting the rent landlords can charge on apartments, the laws usually apply to existing buildings and exempt any buildings not yet built. Advocates of rent control does not argue that this exemption ensures that rent control does not discourage the construction of new housing. Evaluate this argument in light of the time inconsistency problem.
15. GOVERNMENT DEBT

1. Assume that the government sell public telecom company to the private sector. Does such actions by the government reduce the national debt as it is now measure? How would your answer change if the U.S government adopted capital budgeting? Do you think these actions represent a true reduction in the government’s indebtedness?

2. Explaining and evaluating the Ricardian view of government debt.

3. The social Security system levies a tax on workers and pays benefits to the elderly. Suppose that congress increases both the tax and the benefits. For simplicity, assume that the congress announces that the increases will last for one year only.
   a. How do you suppose this change would affect the economy? *(Hint: Think about the marginal propensities to consume of the young and the old.)*
   b. Does your answer depend on whether generations are altruistically linked?

4. Some economists have proposed the rule that the cyclically adjusted budget deficit always be balanced. Compare this proposal to a strict balanced budget rule. Which is preferable? What problems do you see with the rule requiring a balanced cyclically adjusted budget?

17. CONSUMPTION

1. Use the life-cycle model of consumption to discuss a change in the interest rate for a consumer who is a borrower in the first period. Discuss the income and substitution effects on consumption in both periods.

2. Jack an Jill both obey the two-period model of consumption. Jack earns $100 in the first period and $100 in the second period. Jill earns nothing in the first period and $210 in the second period. Both of them can borrow or lend at the interest rate. r?
   a. You observe both Jack and Jill consuming $100 in the first period and $100 in the second period. What is the interest rate r?
   b. Suppose the interest rate increases. What will happen to Jack’s consumption in the first period? Is Jack better off or worse off than before the interest rate rise?
   c. What will happen to Jill’s consumption in the first period when the interest rate increases? Is Jill better off or worse off than before the interest rate increases?

4. Explain whether borrowing constraints increase or decrease the potency of fiscal policy to influence aggregate demand in each of the following to cases:
   a. A temporary tax cut.
   b. An announced future tax cut.

6. Demographers predict that the fraction of the population that is elderly will increase over the next 20 years. What does the life-cycle model predict for the influence of this demographic change on the national saving rate?

7. One study found that the elderly who do not have children dissave at about the same rate as the elderly who do not have children. What might this finding imply about the reason the elderly do not dissave as much as the life-cycle model predicts?
18. INVESTMENT

1. Use the neoclassical model of investment to explain the impact of each of the following on the rental price of capital, the cost of capital, and investment:
   a. Anti-inflationary monetary policy raises the real interest rate.
   b. An earthquake destroys part of the capital stock.
   c. Immigration of foreign workers increases the size of the capital stock.

5. It is an election year, and the economy is in a recession. The opposition candidate campaigns on a platform of passing an investment tax credit, which would be effective next year after she takes office. What impact does this campaign promise have on the economic conditions during the current year?

7. The US tax laws encourage investment in housing and discourage investment in business capital. What are the long-run effects of this policy?

EXERCISE FOR Economics growth students: To be handed in for extra credit.

Combining the intertemporal choice model with endogenous labor supply

In this model, the individual chooses labor supply in two time periods and consumption in 2 time periods.

Assume that Y1 and Y2 are not exogenous from the point of view of the individual. Assume that Y1=W1*L1, where L1=1-R1, where L1 is hours worked in period 1, and R1 is hours of leisure in period 1. 1=L1+R1 equals time endowment (total number of hours available) in period 1 that is normalized to 1.

That is, we assume that the time endowment is not 24 hours but equals 1.

Assume also that Y2=W2*L2, where L2=1-R2, where L2 is hours worked in period 2, and R2 is hours of leisure in period 2 of life. 1=L2+R2 equals total number of hours available in period 2 that are normalized to 1. We also assume that W1 (=nominal wage in period 1) and W2 (=nominal wage in period 2) are exogenous from the point of view of the individual. Assume that the price of current consumption equals 1: P1=1.

Assume: \[ U = C_1^\alpha \cdot C_2^\beta \cdot R_1^\phi \cdot R_2^{1-\alpha-\beta-\phi} \]

Where the preference parameters, \( \alpha, \beta, \phi, 1-\alpha-\beta-\phi \), are all assumed to be between zero and 1.

a) Write up the intertemporal budget constraint of the individual.

b) Derive the optimal levels of C1, C2, R1, R2, L1, L2, and saving as functions of the exogenous variables.

c) What happens to the optimal levels of C1, C2, R1, R2, L1, L2, (and Saving) if W2 increases?

d) What happens if \( r \) increases?

e) What happens if the pension in period 2 increases?

(Here you have to assume that the individual may receive non-labor income
In the second period.)
8. MORE ECONOMIC GROWTH: THE SOLOW MODEL WITH CONTINUOUS TECHNOLOGICAL PROGRESS.

The questions are from the second chapter on economic growth in the textbook of Mankiw. **These problems are not required for B-macroeconomics students** but they are required for the economics growth students.

When doing problems, assume that \( Y(t) = K(t)^\alpha (A(t)L(t))^{(1-\alpha)} \) \( \Rightarrow \tilde{y} = \tilde{k}^\alpha \), where \( \tilde{y} = \frac{y}{A L} \).

Problem 8.1A: Solve for \( \tilde{y} \) as a function of the exogenous variables: \( s, n, \delta \).

Problem 8.1B. A developed country has a saving rate of 28 percent and a population growth rate of 1 percent per year. A less developed country has a saving rate of 10 percent and a population growth rate of 4 percent per year. In both countries, \( g = 0.02 \) and \( \delta = 0.04 \). Find the steady state value of \( \tilde{y} \) for each country.

Problem 8.1C: What policies might the less-developed country pursue to raise its level of income?

Problem 8.2: In the US, the capital share of GDP is about 30 percent; the average growth in output is about 3 percent per year; the depreciation rate is about 4 percent per year; and the capital-output ratio is about 2.5. Suppose that the production function is Cobb-Douglas, so that the capital share in output is constant, and that the US has been in a steady state.

A. What must the saving rate be in the initial steady state? (Hint: Use the steady-state relationship, \( s\tilde{y} = (n + g + \delta) \cdot (\tilde{k}) \).)

B. What is the marginal product of capital in the initial steady state?

C. Suppose that public policy raises the saving rate so that the economy reaches the Golden Rule level of capital. What will the marginal product of capital be at the Golden Rule steady state? Compare the marginal product of capital at the Golden rule steady state to the marginal product of capital in the initial steady state?

D. What will the capital-output ratio be at the Golden Rule steady state? (Hint: For the Cobb-Douglas production function, the capital-output ratio is related to the marginal product of capital.)

Problem 8.3: Prove each of the following statements about the steady state of the Solow model with population growth and technological progress.

A. The capital-output ratio is constant.

B. Capital and labor each earn a constant share of an economy’s income.

C. Total capital income and total labor income both grow at the rate of population growth plus the rate of technological progress, \( n + g \).

D. The real rental price of capital is constant, and the real wage grows at the rate of technological progress, \( g \).

Problem 8.5:

The amount of education the typical person receives varies substantially among countries. Suppose you were to compare a country with a highly educated labor force and a country with a less educated labor force. Assume that education only affects the level of total factor productivity. Assume that the countries are otherwise the same. They have the same saving rate, the same depreciation rate, the same population growth rate, and the same rate of technological progress. Both countries are described by the Solow model and are in their steady states. What would you predict for the following variables? A. The rate of growth of total income. B. The level of income per worker. C. The real rental price of capital. D. The real wage.

Also do question, 8.6. no answer is provided however.
PROBLEM FOR ECONOMICS GROWTH STUDENTS:
Voluntary extra exercise: for extra credit on the exam.
To be handed in: Deadline: XXXXXX.
Allow for long-run technological progress:

\[
(A1): \quad Y(t) = K(t)^\alpha \cdot (A(t) \cdot L(t))^{1-\alpha}, \quad A(t) = A(0) \cdot e^{rt}
\]

Explaining the transition to the equilibrium growth path:
Assume: A(0)=1, s=0.25, and (n+g+d)=0.1, g=0.015, n=0.015, d=0.07.
N(year=0)=100, the starting value: \( k(0) = 2 \).

Fill out the table.

<table>
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<th>Year</th>
<th>K</th>
<th>( y = k^\alpha )</th>
<th>c</th>
<th>i</th>
<th>( \delta \cdot k )</th>
<th>( \Delta \cdot k )</th>
<th>( \Delta \cdot y )</th>
<th>( \Delta \cdot y \cdot \frac{k}{y} )</th>
<th>Real wage</th>
<th>R</th>
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Note= r is real return to capital. r=MPK-depreciation rate.

Briefly comment your results.

A. Plot ln y against time, as well as the equilibrium growth path of ln y.
Briefly comment your results.

B1. What happens to the growth rate and to the equilibrium growth path if s increases?
Assume that the economy in period 0 is on its equilibrium growth path (described by the parameter values above), and that s increases to 0.35.
B2. A make a new table similar to the one above showing the transition to the new steady state growth path. B3. Plot ln y against time, as well as the old and new equilibrium growth paths of ln y. Briefly comment your results.

C1. What happens to the growth rate and to the equilibrium growth path if total factor productivity improves (due to less corruption and more education) increases?
Assume that the economy in period 0 is on its equilibrium growth path (described by the initial parameter values above), and that A(0) increases to 2.
C2. A make a new table similar to the one above showing the transition to the new steady state growth path. C3. Plot ln y against time, as well as the old and new equilibrium growth paths of ln y. Briefly comment your results.
ANSWERS AND SOLUTIONS TO PROBLEMS

1. INTRODUCTION

Answer: Problem 1.3: A fall in the price of frozen yogurt would shift the demand-curve for ice cream inwards, which results in a lower equilibrium price and a lower equilibrium quantity of ice cream. The endogenous variables are the variables that are determined within the model. The price of ice cream and quantity of ice cream are the endogenous variables. The exogenous variables are the variables that are determined outside the model. The price of frozen yogurt is an exogenous variable. Also real income is assumed to be an exogenous variable. Changes in the real income tend to shift the demand-curve of ice cream. Also input prices are assumed to be exogenous variables. Increases in input prices, for example nominal wages, and real energy prices, tend to shift the demand-curve of ice cream upwards.

2. NATIONAL INCOME ACCOUNTING

Answer: Problem 2.1:

a. Current account balance = NX + NFI + net transfers from abroad = 400 + 50 + 0.
b. GNP = labor income + capital income + depreciation of capital + indirect taxes = 900+400+100+200=1600.
c. GDP = GNP – NFI = 1600 – 50 = 1550.
d. GDP = C + G+I+NX: 1550 = C + 300 +150+400. C = 1550 – 850=700
e. National saving = Income – consumption = GNP + net transfers from abroad – (C+G) = 1600 +0 – (700+300)=600.

We can calculate this in a different way:

\[ \text{GNP} + (\text{NFTr}) – (\text{C+G}) = \text{I} + \text{current account balance} = 150+450=600 \]

f. National saving = private saving + public saving


Public saving = taxes – G = 350 – 300=50.

Answer: problem 2.2: The value added by the farmer, the miller, and the baker is 1, 2, and 3. GDP is total value added, or 1 + 2+ 3 = 6, which equals the value of the final good.

Answer: problem 2.3: GDP falls by the amount of the butler’s salary.


Answer: Problem 2.6:

a. Nominal GDP in 2000 = 10 000 000 dollars
Nominal GDP in 2010 = 15 200 000 dollars
Real GDP in 2010 in 2000 year prices = 10 000 000 dollars
Implicit price deflator = 1.52. CPI = 1.6 in 2010.
b. By 52 percent according to the implicit price deflator and by 60 percent by CPI.
CPI is a Laspeyres index and the implicit price deflator is a Paasche index.

Answer: Problem 2.7: A. CPI = 2 in year 2. B. Nominal spending remains constant at 10 dollars. C. Real spending in year 2 in year 1 prices is 20 dollars. D. Implicit price deflator = 0.5 in year 2. E. If Abby thinks that red and green apples are perfect substitutes, the true cost of living is the same in year 1 and in year 2.
Answer: Problem 2.8: A. Real GDP falls. B. Real GDP increases. C. Real GDP falls. D. Real GDP falls. E. Real GDP is likely to fall. F. Real GDP rises but future real GDP may fall. G. Real GDP falls.

3. AGGREGATE SUPPLY: FACTOR MARKETS
Answer: Problem 3.1: A. The real wage falls. B. The real rental price rises. C. The real wage and the real rental price are both likely to increase.
Answer: Problem 3.2: Decreasing returns to scale may occur due to a fixed factor such as land in the production function. Increasing returns to scale may occur due to specialization or due to learning from each other. If a lot of workers there can be learning; so-called clusters.
Answer: Problem 3.3.: A. Labor receives 70 percent of output. B. Output increases by 7 percent. The real wage falls by 2.8 percent and the real rental price of capital increases by 7 percent. C. Output increases by 3 percent. The real rental price of capital falls by 6.5 percent and the real wage increases by 3 percent. D. They all increase by 10 percent.
Answer: Problem 3.4: Real wage = MPL = (1-alpha)*(Y/L).
Production per worker is also called labor productivity.
Answers: 3.5.: A. Their real wage should have increased. B. In terms of farm products. C.-D. Constant real wage in terms of haircuts. E. The real wages measured in the same units will be the same in the two sectors. F. The price of food products fall relative to the price of haircuts when there is technological progress in the agricultural sector. G. Everyone benefits from technological progress in the farm sector.

6. THE LABOR MARKET
Answer: Problem 6.1.: A. If it takes 2 weeks to find a job, then the rate of job finding in weeks is: f = 1 job / 2 weeks = 0.5 job per week. If the job lasts for 12 weeks, then the rate of job separation in weeks is: s = 1 job / 12 weeks = 0.083 jobs per week.
B. U/L=s/(s+f)=0.083/(0.5+0.083)= 0.14. Thus, if on average it takes 2 weeks to find a job that lasts 12 weeks, the natural rate of unemployment for this population of college students seeking part-time employment is 14 percent.
Answer: Problem 6.3: Call the number of residents of the dorm who are involved I, the number who are uninvolved U, and the total number of students T=I+U. In steady state the total number of involved students is constant. For this to happen we need the number of newly uninvolved students, 0.10*I, to be equal to the number of students who just became involved, 0.05*U: 0.05*U=0.10*I→0.05*U=0.10*(T-U). Thus, U/T=0.10/(0.10+0.05)=2/3.
Thus, two-thirds of the students are uninvolved.
Answer: Problem 6.4: U/L=s/(s+f).
The natural rate of unemployment falls if the job finding rate (f) is not affected. However, the job finding rate should go down because raising the cost of firing might make firms more careful about hiring workers.
Answer: Problem 6.5:
A. \( W/P = \text{MPL} = (2/3)*Y/L = (2/3) \cdot K^{1/3} \cdot L^{-1/3} \rightarrow L = (8/27) \cdot K \cdot (\frac{W}{P})^{-1/3} \)

B. We assume that 1000 units of capital and the 1000 units of labor are supplied inelastically (i.e., they will work at any price). In this case we know that all 1000 units of each factor of production will be used in equilibrium, so we can substitute them into the above labor demand function and solve for \( W/P \): \( W/P = \text{MPL} = (2/3)*Y/L = 2/3 \). \( Y = 1000 \). Total labor income = \( (W/P)*L = 2/3*1000 = 666 \).

C. This minimum wage is above the equilibrium real wage, this means that employment will go down: \( L = (8/27)*1000 = 296 \). Thus, employment, output and total labor income decrease. Total compensation to workers = real wage * employment = \( 1*296 = 296 \).

D. The minimum wage helped the employed workers to earn more. However, the high minimum wage made 704 workers unemployed. Moreover, total labor income decreased. This is because the labor demand curve was elastic. Note that if labor demand is less elastic than in this example, then the loss of employment may be smaller, and the change in worker income might be positive.

Answer: Problem 6.6: A. The labor demand curve shifts inwards in the diagram that has the real wage on the y-axis and employment on the x-axis. B. The real wage will fall but employment will remain the same. C. If the real wage cannot fall due to the presence of unions, employment will decrease, and there will be unemployment.

APPENDIX 8: GROWTH ACCOUNTING ("TILLVÄXTBOKFÖRING")

Answer: Problem 8.1A. \( \Delta Y/Y = \alpha \Delta K/K + (1 - \alpha) \Delta L/L + \Delta A/A \)

\( \Delta Y/Y = (1 - \alpha) \Delta L/L = (1/3) \Delta L/L = (1/3)(0.05) = 0.0167 \). Output increases by 1.67 percent.

Growth rate of labor productivity: \( \Delta(Y/L)/L/Y = \Delta Y/Y - \Delta L/L = 0.0167 - 0.05 = -0.034 \)

Labor productivity falls by 3.4 percent. We already assumed that the growth rate of total factor productivity is zero. Answer: Problem 8.1B: \( \Delta A/A = \Delta Y/Y - \alpha \Delta K/K - (1 - \alpha) \Delta L/L = (1/6) - (2/3)(1/6) - (1/3)(1/3) = -0.056 \)

Total factor productivity falls by 5.6 percent.

Answer: Problem 8.3: \( \Delta Y/Y = \alpha \Delta K/K + (1 - \alpha) \Delta L/L + \Delta A/A \Rightarrow \)

\( 0.03 = (0.3)0.03 + (0.7)0.01 + dA/A \Rightarrow 0.03 = 0.009 + 0.007 + dA/A \)

\( \Rightarrow 0.03 = 0.009 + 0.007 + 0.014 \). The contribution of capital is 0.9 percent per year, the contribution of labor is 0.7 percent per year, and the contribution is 1.4 percent per year.

Answer: problem 8.4: \( y(t) = y(t = 0) \cdot (1 + r)^t \rightarrow \left( \frac{y}{y_o} \right)^{1/t} = \left[ (1 + r)^{1/t} \right]^{1/t} = 1 + r \)

\( \rightarrow r = \left( \frac{y}{y_o} \right)^{1/t} - 1 = \left( \frac{222}{194} \right)^{1/5} - 1 = 0.027 \)

Thus, it was 2.7 percent.

Answer: problem 8.5: \( y(t = 0) \cdot (1 + r) = y(t = 0) \cdot (1 + yr)^{30} \)

Where \( r \) is growth rate (= percentage change) during a 30-year period. \( yr \) = average annual growth rate. \( \rightarrow y(t = 0) \cdot (1 + 0.54) = y(t = 0) \cdot (1 + yr)^{30} \rightarrow (1 + 0.54) = (1 + yr)^{30} \rightarrow (1 + 0.54)^{1/30} = 1 + yr \rightarrow yr = 0.014. \)

Thus, the average annual growth rate was 1.4 percent.

Answer: Problem 8.6.

\( \left( \frac{\Delta(Y/L)}{Y/L} \right) = \frac{\Delta Y/Y - \Delta L/L}{0.02} = \Delta Y/Y - 0.03 \rightarrow 0.05 = \Delta Y/Y \)

Thus, the growth rate of GDP was about 5 percent.
Answer problem 8.7A: The absolute difference is first increasing then after 19 years it is decreasing, and it is zero after 52.6 years. 8.7B. The relative difference is decreasing over time.

Answer problem 8.8: Let \( y(t) = y(t = 0) \cdot (1 + 0.05)^t \rightarrow \ln y = \ln(1 + 0.05) \cdot t \)

\[ \ln 2 = \ln(1 + 0.05) \cdot t \approx t = 0.69/0.05 = 13.8 \text{ years}. \]

7. ECONOMIC GROWTH THEORY

Answer problem 7.00: they all increase.

Answer problem 7.01A. The long-run growth rate of \( Y \) and \( K \) is 2 percent (=n+g), and the long-run growth rates of \( Y/L \), of the real wage, and of \( K/L \) is 0 (=g).

Answer problem 7.01B: The long-run growth rate of \( Y \) and \( K \) is 4 percent (=n+g), and the long-run growth rates of \( Y/L \), of the real wage, and of \( K/L \) is 2 (=g).

Answers: Problem 7.1:A. Yes. B. \( y = k^{0.5} \).

C. Country A: \( k=4, y=2, c=1.8 \). Country B: \( k=16, y=4, c=3.2 \).

D.

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<th>Country A</th>
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It will take 5 years before consumption in country B is higher than consumption in A.

Answer: Problem 7.2A. If a war does not affect the capital stock, but reduces the labor force, total output goes down but output per person goes up because \( K/L \) increases.

Answer: Problem 7.2B. If there is technological progress (which there is in the real world), the growth rate of output per person will be slower than the long-run rate as the economy reverts to the old steady state equilibrium. In the steady state, the growth rate of output per worker equals the rate of technological progress. Once the economy returns to the steady state, the growth rate of output per worker therefore equals the rate of technological progress – as it was before the war. (In a MODEL without technological progress, output per person gradually goes down as the economy approaches the old steady state equilibrium.)

Answer: Problem 7.3:A. \( y = k^{0.3} \)

Answer Problem 7.3B. \( k^* = \left( \frac{s}{\delta} \right)^{1/0.7} \), \( y^* = \left( \frac{s}{\delta} \right)^{0.3/0.7} \), \( c^* = (1-s) \cdot y^* = (1-s) \cdot \left( \frac{s}{\delta} \right)^{0.3/0.7} \)

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<th>Saving rate</th>
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A saving rate of 100 percent (s=1.0) maximizes output per worker. Consumption per worker is maximized at a rate of 0.3 percent – that is, where s equals capital’s share in output.

Answer Problem 6.3D. \[ MPK = 0.3 \cdot \left( \frac{K^{0.3} \cdot L^{0.7}}{K} \right) = 0.3 \cdot \frac{Y}{K} \text{, see TABLE.} \]

MPK-depreciation rate = real return to capital.

Answer Problem 7.4:
Suppose the economy begins with an initial steady-state capital stock below the Golden Rule level (where most countries are). The immediate effect of devoting a larger share of national output to investment is that the economy devotes a smaller share to consumption; that is, “living standards” measured by consumption falls. The higher investment rate means that the capital stock increases more quickly, so the growth rate of output and output per worker rise. The productivity of workers is the average amount produced by each worker – that is, output per worker. So productivity growth rises. Hence, the immediate effect is that living standards (as measured by consumption) fall but productivity growth rises.

In the new steady state, output grows at the rate n+g, while output per worker grows at rate g. This means that in the steady state, productivity growth is independent of the rate of investment. Since we begin with an initial steady-state capital stock below the Golden Rule level, the higher investment rate means that the new steady state has a higher level of consumption, so living standards are higher.

Thus, an increase in the investment rate increases the productivity growth rate in the short run but has no effect in the long run. Living standards, on the other hand, fall immediately and only rises over time. That is, the quotation emphasizes growth, but not the sacrifice required to achieve it.

Answer Problem 7.5: The equation for the evolution of k: \[ \Delta k = i - (n + \delta) \cdot k \]
If all capital income is saved and if capital earns its marginal product, then saving per worker equals MPK\#k:
\[ \Delta k = MPK \cdot k - (n + \delta) \cdot k \]
In the steady state: \[ \Delta k = 0 \]. Thus:
\[ MPK \cdot k = (n + \delta) \cdot k \text{ or} \]
\[ MPK = (n + \delta) \]. This condition describes the Golden Rule steady state. Hence, we conclude that this economy reaches the Golden rule level of capital accumulation.

Answer Problem 7.6:
The new steady state has a higher level of capital per worker and hence a higher level of output per worker. What about steady-state growth rates? In the steady state, total output grows at the rate n+g, whereas output per person grows at rate g. Hence, slower population growth will lower the steady-state total output growth rate, but the steady-state per person output growth rate will be the same.
Next consider the transition. We know that the steady-state level of output per person is higher with low population growth. Hence, during the transition to the new steady state, output per person must grow faster than g (the long-run growth rate of technology) for a while. In the decades after the fall in population growth, growth in total output will fall while growth in output per person will rise.

Answer. Problem 7.10: \[ k^* = \left( \frac{s \cdot A}{n + \delta} \right)^{\frac{1}{1-\alpha}}, \quad y^* = A \cdot (k^*)^\alpha = A \cdot \left( \frac{s \cdot A}{n + \delta} \right)^{\frac{\alpha}{1-\alpha}} \]

\[ W/P = MPL = (1 - \alpha) \cdot A \cdot k^\alpha = (1 - \alpha) \cdot y \]

\[ r + \delta = \alpha \cdot A \cdot k^{\alpha-1} = \alpha \cdot A \cdot \left( \frac{sA}{n + \delta} \right)^{\frac{\alpha}{1-\alpha}} = \alpha \cdot A \cdot \left( \frac{sA}{n + \delta} \right)^{\frac{\alpha}{1-\alpha}} = \alpha \cdot A \cdot \left( \frac{sA}{n + \delta} \right)^{\frac{\alpha}{1-\alpha}} = \alpha \cdot A \cdot \left( \frac{n + \delta}{sA} \right)^{\frac{\alpha}{1-\alpha}} = \alpha \cdot \frac{(n + \delta)}{s} \cdot \left( \frac{sA}{n + \delta} \right)^{\frac{\alpha}{1-\alpha}} \]

.: If saving rate \( k \uparrow \Rightarrow W/P \uparrow \) and \( r \downarrow \)

4. MONEY AND INFLATION

Answer: Problem 4.1: A. A credit card is a medium of exchange.
B. A painting is a store of value. C. A subway token, within the subway system, satisfies all 3 functions of money, which are store of value, unit of account, and medium of exchange.

Answer: Problem 4.2: Use the quantity equation to calculate the inflation rate. Using this rate of inflation and the Fischer equation yields a real interest rate of 2 percent.

Answer: Problem 4.5. Paper weapon might create inflation, and even hyperinflation.

Answer: Problem 4.6: If the debt is in nominal terms (which is the usual case; that is, in dollars), inflation reduces the real value of. Inflation has to be unexpected. If high inflation is expected, banks demand a higher (fixed) nominal interest rate. So if you are debtor and have a fixed nominal interest rate and the actual inflation rate is higher than the expected one, you are happy. This is because your actual real interest rate on your loan becomes lower than the expected real interest rate. If you have a floating interest rate, a higher actual inflation rate should not matter as the nominal interest rate tends to adjust.

Answer: Problem 4.7: A deflation is a fall in the general price level, which is the same as a rise in the value of money. Under a gold standard, a rise in the value of money is a rise in the value of gold because money and gold are in a fixed ratio. Therefore, after a deflation, an ounce of gold buys more goods and services. This creates an incentive to look for new gold deposits and, thus, more gold is found after a deflation.
3. THE KEYNESIAN MODEL FOR A CLOSED ECONOMY IN THE LONG RUN=CLASSICAL MODEL FOR THE CLOSED ECONOMY

Answer: Problem 3.7: \( \text{National Saving} = (Y - T - C(Y - T)) + [T - G] \)
A. Increases by 100 billions. B. Private consumption falls by 60 billions. Thus, private saving falls by 40 billions. C. National saving increases by 60 billions. D. National saving equals investment.

Answer: Problem 3.8: If households’ consumption increases at a given disposable income, the national saving and investment will go down, and the interest rate will increase.

Answer: Problem 3.9:

a+b. \( S = 750, \text{priv } S = 750, \text{public } S = 0, r = 5 \% \)
c+d. \( S = 500, \text{priv } S = 750, \text{public } S = -250, r = 10 \% \)
e. \( S = 562.5, \text{priv } S = 812.5, \text{public } S = -250, r = 8.75 \% \)

Answer: Problem 3.10: \( \text{National Saving} = (Y - T - C(Y - T)) + [T - G] \)
\[ \Delta \text{National Saving} = \left[ \Delta Y - \Delta T - MPC \cdot (\Delta Y) + MPC \cdot (\Delta T) \right] + [\Delta T - \Delta G] \]
\[ \Delta \text{National Saving} = [-\Delta T + MPC \cdot (\Delta T)] + 0 \]
\[ \Delta \text{National Saving} = (MPC - 1) \cdot \Delta T \] In plain English: public saving is unaffected. Private saving decreases because the households’ disposable income decreases more than private consumption because the marginal propensity to consume is less than one. As national saving decreases, and the interest rate increases.

Answer: Problem 3.11: A. The demand curve for business investment shifts out, the demand curve for residential investment stays put. B. The real interest rate increases because the total demand curve for investment in the economy shifts out. C. Investment is unchanged as national saving is fixed. The quantity of business investment goes up whereas the quantity of residential investment goes down.

Answer: Problem 3.12: Qualitatively the conclusions remain. But the more responsive consumption and private saving is to the interest rate, the less government purchases crowd out investment.

5. THE KEYNESIAN MODEL FOR A SMALL OPEN ECONOMY IN THE LONG RUN=THE CLASSICAL MODEL FOR THE SMALL OPEN ECONOMY

Answer: Problem 5.1: A. Real exchange rate depreciates and the trade balance improves. B. The real exchange rate depreciates, and the trade balance is unchanged. C. Introduction of automatic teller machines reduces the real demand for money given the fixed interest rate and the fixed output level. As nominal supply is fixed, the price level has to fall to obtain equilibrium in the money market. There is no effect on the real exchange rate, which means that the nominal exchange rate has to depreciate. No effect on the real exchange rate means that the trade balance is unchanged.

Answer: Problem 5.2: a. S=I=750, NX=0, real exch. rate =1. b. S=500, I=750, NX=-250, real exch. rate =1.5 c. S=750, I=500, NX=250, real exch. rate = 0.5.

Answer: Problem 5.3: A. The trade balance-schedule shifts to the left. In other words, NX decreases at a given real exchange rate. The real exchange rate depreciates. National saving,
Y-C-G, does not change. Also the interest rate and investment are unchanged. Net exports are unchanged.
B. It will be more expensive to travel abroad in the domestic currency of Leverett. In other words, imports of tourist services become more expensive.
C. If the government reduces taxes, aggregate saving will fall, which leads to a fall in NX which is induced by an appreciation of the real exchange rate. The interest rate and investment are unchanged.

Answer: Problem 5.5: An increase in government spending decreases aggregate saving, which leads to an appreciation of the real exchange rate, which makes domestic goods more expensive and foreign goods cheaper, which leads to a fall in NX. A world war implies that many governments increase spending which leads to less aggregate saving and a higher interest rate. A higher interest decreases investment. If the fall in investment is larger than the decrease in aggregate saving, the trade balance improves: NX increases!

Answer: Problem 5.6: A. Investment demand increases at a given interest rate because better technology increases MPK. B. increases. C. increases. D. The trade balances of rich countries improve as National saving minus investment increases: S-I=NX.

Answer: Problem 5.7: The NX-schedule shifts out (NX increases at a given real exchange rate), which implies that the real exchange rate appreciates. NX is unaltered. The stronger real exchange rate increases imports and puts pressure on the sales of American companies with the exception of American luxury car production, which is shielded by the tariff. Also American exporters will be hurt by the higher exchange rate, which makes their goods more expensive to foreign countries. Consumers of Japanese luxury cars will be hurt by the tariffs while all other American consumers will benefit from the appreciated dollar, which allows them to purchase foreign goods more cheaply. In sum, the policy would shift demand to American luxury car producers at the expense of the rest of American production and also shift consumption from Japanese luxury cars to all other imports.

Answer: Problem 5.8: 
A+B. World interest rate increases as a result of an outward shift of the world investment demand-schedule. C. Lower investment. D. NX increases. E. To bring about the increase in the trade balance, the real exchange rate depreciates.

Answer: Problem 5.9: Percentage increase in the real exchange rate = percentage increase in the nominal exchange rate (Peso/USD) + domestic inflation in the US– foreign inflation = 50% + 25 percent – 100 percent = - 25 percent. The real exchange rate of the dollar visavi the Mexican peso depreciates by 25 percent. A depreciation of the real exchange rate makes foreign goods more expensive and domestic goods cheaper. Thus, the friend should be wrong as it now should be more expensive to travel in Mexico.

Answer: Problem 5.10: A. The expected inflation rate is 4 percentage points higher in Canada. B. The Canadian dollar is expected to depreciate by 4 percent. C. He does not take the expected depreciation of the Canadian dollar into account. Assume that he borrows 1 US dollar from an American bank at 8 percent, exchanges it for 1 Canadian dollar, and puts it in a Canadian bank. At the end of the year he will have 1.12 Canadian dollars, which then is expected to be worth 1.08 US dollars, which is the amount owed to the US Bank.
9. INTRODUCTION TO THE KEYNESIAN MODEL IN THE SHORT AND LONG RUN FOR A CLOSED ECONOMY

Do almost all problems but we (in contrast to the textbook) use the regular AD-curve: 
AD= C(Y-T)+I(real interest rate)+G to answer the questions. In other words, we use the AD-curve from Chapter 3.


Answer: Problem 9.1: A. Demand for real money increases at given levels of income and at a given level of the interest rate on government bonds. Increased demand for real money when real money supply (M/P) is constant bids up the nominal interest rate on government bonds. 
B. V=PY/M falls. Because interest rate on money holdings encourage people to hold more money. 
C. A higher interest rate decreases investment demand and thereby aggregate demand: the AD-curve shifts to the left. Output decreases but the price level is constant in the short run. In the long run: an output level below the potential level of output, decreases nominal wages and the price level, which increases the real money supply (M/P) until the nominal interest rate reverts back to its initial level. In the new long run equilibrium: the output level is back to its initial long-run equilibrium level and the price level is lower than in the initial long-run equilibrium. The nominal interest is back to its initial level. All real variables, including M/P, are back to their initial long-run equilibrium levels. 
D. If the central bank increases the nominal money supply (M) the interest rate needs not increase. Thus, output needs not fall below the potential level.

Answer: Problem 9.2: A. If M ↓→ M/P ↓→ Nominal interest rate ↑. Note: nominal interest rate = real interest rate when P is constant. → Investment (real interest rate) ↓. Thus, the AD-curve shifts to the left. 
B. The price level is constant in the short run. The output level decreases. The new short run equilibrium implies that actual unemployment is higher than the natural rate. Over time, when output is below the potential level (= employment is below the full-employment level) the nominal wage falls which shifts the SRAS-curve downwards, which results in a lower price level. In the new long-run equilibrium: output is back at the potential level, price level is lower, M/P and the interest rate are back at their initial levels.
C. The real interest rate increases first, but over time it returns to its initial long-run equilibrium level. Why? Over time: P ↓→ M/P ↑→ nominal and real interest rate ↓→ Investment ↑. Over time, the economy returns to its long-run equilibrium output with a lower price level. In sum: Monetary policy (changes in nominal money supply, M) has no effects on real variables in the long run; that is, on output, employment, unemployment, the real interest rate, and investment. The only long-run effect is on a nominal variable: the price level.

Answer: Problem 9.3: A. An exogenous decrease in the velocity of money causes the aggregate demand curve to the left, the central banks should shift this curve back by increasing the money supply. 
B. An exogenous increase in the price of oil causes the short-run aggregate supply curve to shift up. If the central bank cares about stable prices, there is no policy response it can implement to lower the price level with a horizontal SRAS-curve. If the central bank cares about keeping output and employment at their natural-rate levels, then the fed should increase the money supply and thereby shift the aggregate demand curve upwards.
10. THE SIMPLE KEYNESIAN MODEL FOR THE SHORT RUN FOR A CLOSED ECONOMY. Assumption: the real interest rate is constant, and the SRAS-curve is horizontal.

Answer: Problem 10.2: B. The equilibrium level of income is 1300. C. Y=1400. D. G must increase to 175.

Answer: Problem 10.3: A. When taxes do not depend on income, a one-dollar increase in income means that disposable income increases by one dollar. When taxes do depend on income, a one-dollar increase in income increases disposable income by (1-t) dollars. Consumption increases by the product of the MPC and the change in disposable income.

   A. The government-purchases multiplier becomes 1/(1-(1-t)MPC) rather than 1/(1-MPC).
   B. :

   \[ Y^* = \frac{\bar{C} - MPC \cdot \bar{T} + I_0 + \bar{G}}{1 - MPC \cdot (1-t)} \cdot \frac{d}{1 - MPC \cdot (1-t)} \cdot r \]

Answer: Problem 10.4: A. The planned-expenditure function shifts down and equilibrium income falls.
B. Equilibrium saving remains unchanged as investment remains unchanged. Saving equals investment. C. The paradox of thrift is that even though thriftiness increases, saving is unaffected. Increased thriftiness leads only to a fall in income. D. It does not arise as the interest rate adjusts to equilibrate saving and investment, where investment depends on the interest rate.
11. THE KEYNESIAN MODEL FOR A CLOSED ECONOMY.

THE IS-LM-MODEL FOR A CLOSED ECONOMY:
The SRAS-curve is horizontal and P is fixed.
Assumption: the real interest rate is flexible.

Problem 11.1:
A. Interest rate falls, and investment increases. The increase in disposable income causes consumption to rise.
B. When government purchases increase, aggregate demand and income increases by \(\frac{1}{1-MPC}(G_1-G_0)\) if the interest rate is constant. However, both income and the interest rate increase. The increase in disposable income causes consumption to rise, while the increase in the interest rate causes investment to fall.
C. The tax multiplier is \(-\frac{MPC}{1-MPC}(T_1-T_0)\) if the interest rate is constant. However, both income and the interest rate both fall. Disposable income falls and consumption falls as a result. The fall in the interest rate causes investment to rise.
D. \((Y_1-Y_0)=\frac{1}{1-MPC}(G_1-G_0) - \frac{MPC}{1-MPC}(T_1-T_0)\). Because \(G_1-G_0=T_1-T_0\), we find that \(Y_1-Y_0=G_1-G_0\). Thus, output would increase by the amount that \(G\) increases if the interest rate were constant. However, the interest rate increases, causing investment to fall. Output increases, but by less than the amount that \(G\) and \(T\) increase; this means that disposable income, \(Y-T\), falls. As a result, consumption also falls.

Problem 11.2:
A. The invention of the new high-speed chip increases investment demand at a given interest rate. That is, at every interest rate, firms want to invest more. The increase in income from the higher investment demand also raises interest rates. This happens because the higher income raises demand for money; since the supply of money does not change, the interest rate must rise in order to restore equilibrium in the money market. The rise in interest rates partially offsets the increase in investment demand. Overall, income, interest rates, consumption, and investment all rise.
B. An increased demand for cash (at any given level of income and money supply) means that the interest rate necessary to equilibrate the money market is higher. A higher interest rate decreases investment demand and thereby output, which lowers private consumption.
C. At any given level of income, consumers now wish to save more and consume less. The effects are: Income, interest rates, and consumption all fall, while investment rises.

Problem 11.3:
C. Equilibrium \(r=6\), and equilibrium \(Y=1100\).
D. Equilibrium \(r=7\), and equilibrium \(Y=1200\).
E. Equilibrium \(r=5.5\), and equilibrium \(Y=1150\).
F. Equilibrium \(r=7.25\), and equilibrium \(Y=975\).
G. Equation for goods market equilibrium: \(Y=1700-100r\); \(100r=1700-Y\)
Equation for money market equilibrium: \((M/P)=Y-100r; 100r=Y-(M/P)\).
Combining these 2 equations: \(1700-Y=Y-(M/P); Y=850+M/2P\)
Since \(M=1000\): \(Y=850+500/P\). If \(G\) increases and \(M\) increases the aggregate demand curve shifts to the right.
Problem 11.5:
The government should increase money supply but decrease G or increase T.
The policy mix of the early 1980s did exactly the opposite. The effect was a high interest rate
and a low investment demand.

Problem 11.6:
A. Short-run: The interest rate decreases and investment demand increases. Output and
consumption increase. Long-run effects: Since the level of output is now above its
long-run level, prices begin to rise. A rising price level lowers real balances, which
raises the interest rate: Prices continue to rise until the economy returns to its original
position. The interest rate and the investment demand return to their original levels.
Thus, in the long run, there is no impact on real variables from an increase in the
money supply. (This is what we call monetary neutrality.)
B. Short-run effect: Interest rate and output increase. The increase in the interest rate reduces
investment and “crowds out” part of the expansionary effect of the increase in government
purchases. Long-run effects: As output is above its long-run equilibrium level, prices begin to
rise, which reduces real balances, M/P, and increases the interest rate even more than in the
short run. This process continues until the long-run level of output is again reached. At the
new long-run equilibrium, the interest rate and the price level are higher. Note that, like
monetary policy, fiscal policy cannot change the long-run equilibrium of output. Unlike
monetary policy, however, it can change the composition of output. For example, in the new
long-run equilibrium the level of investment is lower than it was in the old long-run
equilibrium.
C. An increase in taxes reduces disposable income for consumers. In the short run, output and
the interest rate decline. Long-run: Prices begin to decline because output is below its long-
run equilibrium level, which increases the real money supply. Interest rates fall even further
and further stimulate investment and increase income. In the long run, output returns to its
long-run equilibrium level. The price level and the interest rate are lower, and the decrease in
consumption has been offset by an equal increase in investment.

Problem 11.7:
A. If all shocks to the economy arise from exogenous changes in the demand for goods and
services, It is clear that output fluctuates less if the Fed follows a policy of keeping the money
supply constant instead of keeping the interest rate constant.
B. If all shocks in the economy arise from exogenous changes in the demand for money, It is
clear that output fluctuates less if the FED holds the interest rate constant.
12. The Keynesian model in the short run for a small open economy. (The SRAS-curve is horizontal and P is fixed.) Assumption: the real interest rate is fixed but the nominal and the real exchange rate are flexible. The IS-LM-model for a small open economy.

Problem 12.1: A. If consumers decide to spend less and save more, $\bar{C}$ decreases. Output is unchanged. The exchange rate depreciates, which causes an increase in the trade balance equal to the fall in consumption. B. implies that the NX falls at a given exchange rate. Output does not change, while the exchange rate depreciates. The trade balance does not change, despite that the exchange rate has depreciates. We know this since $NX=S-I$, and both saving and investment remain unchanged. C. The introduction of ATM machines reduces the demand for money. We know that equilibrium in the money market requires that the supply of real money balances, $M/P$, must equal demand: $M/P=L(r,Y)$. A fall in money demand means that for unchanged income and interest rates, the right-hand side of this equation falls. Since $M$ and $P$ are both fixed, we know that the left-hand side of this equation cannot adjust to restore equilibrium. We also know that the interest rate is fixed at the level of the world interest rate. This means that income – the only variable that can adjust – must rise in order to increase the real demand for money.

Problem 12.2: Increase $M$ and $G$ or increase $M$ and decrease $T$.

Problem 12.3: A. The world interest rate is the rate that equilibrates world saving and world investment. Anything that reduces world saving or increases world investment demand increases the world interest rate. In the short run when prices are fixed, anything that increases the worldwide demand for goods or reduces the worldwide supply of money causes the world interest rate to rise. B. The higher interest rate causes investment to fall, and the higher interest rate reduces real money demand. Since the supply of real balances, $M/P$, is fixed, the higher interest rate leads to an excess supply of real balances. To restore equilibrium in the money market, income must rise; this increases the real demand for money until there is no longer an excess supply. Output rises and the exchange rate depreciates. NX increases.

Problem 12.4: A. A depreciation of the currency makes American goods cheaper so that foreigners buy more of them. For example, suppose the exchange rate between yen and dollars falls from 200 yen/dollar to 100 yen/dollar. If an American can of tennis balls costs 2.50 dollars, its price in yen falls from 500 to 250 yen. This fall in price increases the quantity of American-made tennis balls demanded in Japan. That is, American tennis balls become more competitive. B. Raise taxes or decrease government purchases causes the exchange rate to depreciate.

Problem 12.5: If world income increases NX increases at a given exchange rate. A. Fiscal expansion (an increase in government spending or a cut in taxes) does not increase income but the real exchange rate appreciates and NX falls. Income does not increase as real money supply, $M/P$, and the world real interest rate are unchanged.

Problem 12.7B. An increase in $G$ or a cut of taxes do increase $Y$. Like before, the currency appreciates, which decreases $P$ because imported goods and services become less expensive in domestic currency. In standard Mundell-Fleming model, fiscal policy has no impact on $Y$. An increase in $G$ increases the exchange rate so that $NX$ falls by the same amount.
13: The Keynesian model in the short and long run with a positively sloped SRAS-curve.
The AS/AD-model.

Problem 13.2:
A. Full indexing means that unexpected price changes do not affect the real wage and, hence, do not affect the amount of labor used or the amount of output produced. The aggregate supply schedule is thus vertical at the full-employment output level.
B. If there is partial indexing, then the aggregate supply curve will be steeper than it is without indexing, although it will not be vertical. In the sticky-wage model, an unexpected increase in the price level reduces the real wage \( W/P \), since the nominal wage \( W \) is unaffected. With partial indexing, the increase in the price level causes an increase in the nominal wage. Since the indexing is only partial, the nominal wage increases by less than the price level does, so the real wage falls. This causes firms to use more labor and increase production. However, the real wage does not fall as much as it does without indexing, so output does not rise as much. In effect, this is like making the parameter alpha smaller in the equation for aggregate supply. That is, output fluctuations become less responsive to surprises in the price level.

Problem 13.3:
A. The natural rate of unemployment is the rate at which the inflation rate does not deviate from the expected inflation rate. Here, the expected inflation rate is just last period’s actual inflation rate. Setting the inflation rate equal to last period’s inflation rate, we find that \( u=0.06 \), which is the natural rate of unemployment.
B. In the short run (that is, in a single period) the expected inflation rate is fixed at the level of inflation in the previous period. Hence, the short run Phillips-curve has a slope of \(-0.5\) and passes through the point where actual inflation equals last period’s inflation and \( u=0.06 \). In the long-run, expected inflation equals actual inflation, so that inflation equals last period’s inflation, and output and unemployment equal their natural rates. The long-run Phillips Curve thus is vertical at an unemployment of 6 percent.
C. To reduce inflation, the Phillips curve tells us that unemployment must be above its natural rate of 6 percent for some period of time. We can write the Phillips curve in the form: Actual inflation – last period’s inflation = 0.5(u-0.06). Since we want inflation to fall by 5 percentage points, we want (actual inflation – last period’s inflation)= -0.5. Plugging this into the left-hand side of the above equation, we find that -0.05=-0.5(u-0.06). Solving for \( u \): \( u=0.16 \). Hence, we need 10 percentage point-increase of cyclical unemployment above the natural rate of 6 percent.

Okun’s law says that a change of 1 percentage point in unemployment translates into a change of 2 percentage points in GDP. Hence, an increase in unemployment of 10 percentage points corresponds to a fall in output of 20 percentage points. The sacrifice ratio is the percentage of a year’s GDP that must be forgone to reduce inflation by 1 percentage point. Dividing the 20 percentage point decrease in GDP by the 5 percentage point decrease in inflation, we find that the sacrifice ratio is 20/5=4.
D. One scenario is to have very high unemployment for a short period of time. For example, we could have 16 percent unemployment for a single year. Alternatively, we could have a small amount of cyclical unemployment spread out over a long period of time. For example, we could have 8 percent unemployment for 5 years. Both of these plans would bring the inflation rate down from 10 percent to 5 percent, although at different speeds.
Problem 13.4:
The cost of reducing inflation comes from the cost of changing people’s expectations about inflation. If expectations can be changed costlessly, then reducing inflation is also costless. Algebraically, the Phillips curve tells us:

\[
\text{Actual inflation} = \text{expected inflation} - b*(u-\text{natural rate of } u).
\]

If the government can lower expected inflation to the desired level of inflation, then there is no need for unemployment to rise above its natural rate.

If everyone believes that the government is committed to reducing inflation, then expected inflation will immediately fall. Thus, the sacrifice ratio will be small. It is thus important to make its commitment to reducing inflation credible. One possibility is to appoint people who have a reputation as inflation fighters to bosses at the central bank. A second possibility is to pass a law requiring the central bank to have an inflation target. Or pass a law, that limits monetary growth.

Problem 13.5:
In this question we consider several implications of rational expectations – the assumption that people optimally use all of the information available to them in forming their expectations- for the models of sticky wages and sticky prices that we considered in this chapter. Both of these models imply an aggregate supply curve in which output varies from its natural rate only if the price level varies from its expected level:

\[
Y = \bar{Y} + \alpha \cdot (P - P')
\]

This aggregate supply curve means that monetary policy can affect real GDP only by affecting \((P - P')\) - that is, causing an unexpected change in the price level.

A. Only unanticipated changes in the money supply can affect real GDP. Since people take into account all of the information available to them, they already take into account the effects of anticipated changes in money when they form their expectations of the price level. For example, if people expect the money supply to increase by 10 percent and it actually does increase by 10 percent, then there is no effect on output since there is no price surprise: \((P - P') = 0\). On the other hand, suppose the fed increases the money supply more than expected, so that prices increase by 15 percent when people expect them to increase by only 10 percent. Since actual \(P\) > expected \(P\), output rises. But it is only the unanticipated part of money growth that increases output.

B. The Fed often tries to stabilize the economy by offsetting shocks to output and unemployment. For example, it might increase the money supply during recessions in an attempt to stimulate the economy, and it might reduce the money supply during booms in an attempt to slow it down. The fed can only do this by surprising people about the price level: during a recession, they want prices to be higher than expected, and during booms, they want prices to be lower than expected. If people have rational expectations, however, they will expect the fed to respond this way. So if the economy is in a boom, people expect the fed to reduce the money supply; in a recession, people expect the fed to increase the money supply. In either case, it is impossible for the fed to cause \((P - P')\) to vary systematically from zero. Since rational people take into account the systematic, anticipated movements in money, the effect on output of systematic, active policy is exactly the same as a policy of keeping the money supply constant.

C. If the fed sets the money supply after people set wages and prices, then the fed can use monetary policy systematically to stabilize output. The assumption of rational expectations means that people use all of the information available to them in forming expectations about the price level. This includes information about the state of the economy and information about the fed will respond to this state. This does not mean that people know what the state of
the economy will be, nor do they know exactly how the fed will act: they simply make their best guess.

As time passes, the fed learns information about the economy that was unknown to those setting wages and prices. At this point, since contracts have already set these wages and prices, people are stuck with their expectations of \( P \). The fed can then use monetary policy to affect the actual price level \( P \), and hence can affect output systematically.

**Problem 13.6:**

In this model, the natural rate of unemployment is an average of the unemployment rates in the past 2 years. Hence, if a recession raises the unemployment rate in some year, then the natural rate of unemployment rises as well. This means that the model exhibits hysteresis: short-term cyclical unemployment affects the long-term natural rate of unemployment.

A. The natural rate of unemployment might depend on recent unemployment for at least 2 reasons, suggested by theories of hysteresis. First, recent unemployment rates might affect the level of frictional unemployment. Unemployed workers lose job skills and find it harder to get jobs; also unemployed workers might lose some of their desire to work, and hence search less hard for a job. Second, recent unemployment rates might affect the level of wait unemployment. If labor negotiations give a greater voice to “insiders” than “outsiders”, then the insiders might push for high wages at the expense of jobs. This will be especially true in industries in which negotiations take place between firms and unions.

B. If the Fed seeks to reduce inflation permanently by 1 percentage point, then the Phillips curve tells us that in the first period we require:

\[
\pi_1 - \pi_0 = -1 = -0.5(u_1 - u^n_0)
\]

Or

\[
(u_1 - u^n_0) = 2
\]

That is, we require an unemployment rate 2 percentage points above the original natural rate \( u^n_0 \). Next period, however, the natural rate will rise as a result of the cyclical unemployment.

The new natural rate \( u^n_2 \) will be

\[
u^n_2 = 0.5(u_1 - u_0) = 0.5((u^n_0 + 2) + u^n_0) = u^n_1 + 1
\]

Hence, the natural rate of unemployment rises by 1 percentage points. If the fed wants to keep inflation at its new level, then unemployment in period 2 must equal the new natural rate \( u^n_2 \).

Hence, \( u_2 = u^n_0 + 1 \)

In every subsequent period, it remains true that the unemployment rate must equal the natural rate. This natural rate never returns to its original level:

\[
u_3 = (0.5)u_2 + (0.5)u_1 = u^n_2 + 1 - 0.5
\]

\[
u_4 = (0.5)u_3 + (0.5)u_2 = u^n_2 + 1 - 0.25
\]

\[
u_5 = (0.5)u_4 + (0.5)u_3 = u^n_2 + 1 - (3/8)
\]

Unemployment always remains above its original natural rate. In fact, we can show that it is always at least 1 percent above its original natural rate. Thus, to reduce inflation by 1 percentage points, unemployment rises above its original level by 2 percentage points in the first year, and by 1 or more percentage points in every year after that.

C. Because unemployment is always higher than it started, output is always lower than it would have been. Hence, the sacrifice ratio is infinite.

D. Without hysteresis, we found that there was a short-run tradeoff but no long-run tradeoff between inflation and unemployment: to reduce inflation, unemployment must rise permanently.
7A. A. increases. B. AD-curve; LRAS- and SRAS-curves shift out.
7C. Output increases, the effect on the price level is uncertain.
Without the labor supply effect: output and the price level both increases.
7D. Output increases, the effect on the price level is uncertain.
Without the labor supply effect: output and the price level both increases.

14. STABILIZATION POLICIES

Problem 14.1:
A. If expectations are perfectly rational and wage contracts can be adjusted immediately when a new party comes into power, then there will be no political business cycle pattern to unemployment. We do however observe a political business cycle pattern to inflation, in which democrats have high inflation and republicans have low inflation. Now suppose that wage contracts are long enough that nominal wages and prices cannot be adjusted immediately. Before the result of a coin flip is known, there is a fifty percent chance that inflation will be high and a 50 percent chance that inflation will be low. Thus, at the beginning of each term, if people’s expectations are rational, they expect an inflation rate of:
\[ \pi^e = 0.5(\pi^d) + 0.5(\pi^r) \]
If democrats win the coin toss, then actual inflation is higher than expected inflation, and unemployment falls below its natural rate, and the opposite happens if the republicans win.

B. If the two parties take turns, then there will be no political business cycle to unemployment, since everyone knows which party will be in office, so everyone knows whether inflation will be high or low.

Problem 14.2:
There is a time-inconsistency problem with an announcement that new buildings will be exempted from rent-control laws. Before new housing is built, a city has an incentive to promise this exemption: landlords then expect to receive high rents from the new housing they provide. Once the new housing has been built, however, a city has an incentive to renege on its promise not to extend rent control. That way, many tenants gain while a few landlords lose. The problem is that builders might expect the city to renege on its promise; as a result, they may not build new buildings.
15. GOVERNMENT DEBT
Problem 15.1: With capital budgeting, the net national debt would be defined as the assets of the government (schools, parks, etc) minus the liabilities of the government (principally outstanding public debt). By selling public utility and telecom companies the government would be reducing its assets by the value of the telecom companies and reducing its liabilities by its purchase price. Assuming the private sector paid a fair price for these companies, these reductions would be the same amount and the net national debt would be unchanged.

Problem 15.3. A. Assume the life-cycle model of consumption and that people wants to smooth consumption. The transfer of wealth to the elderly causes a net increase in consumption, and, therefore, a decrease in saving. This happens because the elderly increase consumption by more than the workers decrease it, because the elderly have fewer years to live and thus have a higher marginal propensity to consume.

B. The answer in A. does depend on whether generations are altruistically linked. If generations are altruistically linked, then the elderly may not feel any better off because of the social security benefit, since the tax and benefit increase has no effect on a typical family’s permanent income; it simply transfers resources from one generation of the family to another. If the elderly do not want to take advantage of this opportunity to consume at their children’s expense, they may try to offset the effect of the tax increase on the young by giving them a gift or leaving a bequest. To the extent that this takes place, it mitigates the impact of the tax change on consumption and saving.

Problem 15.4: A rule requiring a cyclically adjusted balanced budget allows the government to run countercyclical fiscal policy in order to stabilize the economy. That is, the government can run deficits during recessions, when taxes automatically fall and expenditures automatically rise. These automatic stabilizers affect the deficit but not the cyclically adjusted deficit. Second, this rule allows the government to smooth tax rates across years when income is especially low or high - it is not necessary to raise tax rates in recessions or cut them in booms.
17. CONSUMPTION

Problem 17.1: First-period consumption falls unambiguously when the real interest rate rises, since both the income and substitution effects push in the same direction. Second-period consumption might rise or fall, depending on which of the substitution effect or the income effect is larger. If the substitution effect is stronger than the income effect, second-period consumption increases.

Problem 17.2:
   A. \( R = 10 \) percent.
   B. The rise in interest rates leads Jack to consume less today and more tomorrow. This is because of the substitution effect: it costs him more to consume today than tomorrow because of the higher opportunity cost in terms of foregone interest. We know Jack is better off: at the new interest rate he could still consume 100 dollars in each period, so the only reason he would change his consumption pattern is if the change makes him better off.
   C. Jill consumes less today while her consumption tomorrow can either rise or fall.

Problem 17.4:
   A. The marginal propensity to consume is higher for a consumer who faces a borrowing constraint. Therefore, fiscal policy has a larger effect on aggregate demand with binding borrowing constraints than it is without them.
   B. Announcement of a future tax cut has no effect on consumption or aggregate demand if consumers face binding borrowing constraints.

Problem 17.6: The life-cycle model predicts that an important source of saving is that people save while they work to finance consumption after they retire. That is, the young save, and the old dissave. If the fraction of the population that is elderly will increase over the next 20 years, the life-cycle model predicts that as these elderly retire, they will begin to dissave their accumulated wealth in order to finance their retirement consumption: thus, the national saving rate should fall over the next 20 years.

Problem 17.7: In this chapter we discussed 2 explanations for why the elderly do not dissave as rapidly as the life-cycle model predicts. First, because of the possibility of unpredictable and costly events, they may keep some precautionary saving as a buffer in case they live longer than expected or have large medical bills. Second, they may want to leave bequests to their children, relatives, or charities, so again, they do not dissave all of their wealth during retirement.

If the elderly who do not have children dissave at the same rate as the elderly who do not have children, this seems to imply that the reason for low dissaving is the precautionary motive; the bequest motive is presumably stronger for people who have children than those who do not. An alternative interpretation is that perhaps having children does not increase desired saving. For example, having children raises the bequest motive, but it may also lower the precautionary motive: you can rely on your children in case of financial emergency. Perhaps the 2 effects on saving cancel each other.
18. INVESTMENT
Problem 18.1:
A. A rise in the real interest rate increases the cost of capital. Investment declines because firms no longer find it as profitable to add to their capital stock. Nothing happens immediately to the real rental price of capital, because MPK does not change.
B. MPK increases, which implies that the real rental price of capital increases. Because MPK rises relative to the cost of capital (which does not change), firms find it profitable to increase investment.
C. If an immigration of foreign workers increases the size of the labor force, then MPK increases and hence the real rental price of capital increase. Because MPK increases relative to the cost of capital (which does not change), firms find it profitable to increase investment.

Problem 18.5:
Current investment falls, and hence current aggregate demand falls if managers postpone investments in anticipation of a future investment tax credit.

Problem 18.7: Residential investment increase, but we get a lower steady-state capital stock per worker in the business sector.

8. MORE ECONOMIC GROWTH: MODEL WITH TECHNOLOGICAL PROGRESS.
Answer: Problem 8.1 A. \( \ddot{y} = \tilde{k}^{1/2} \Rightarrow \ddot{y}^2 = \tilde{k} \cdot \ddot{y}^* = s(n + g + \delta) \)
Problem 8.1B. \( \ddot{y}^* = 4 \) in rich country. \( \ddot{y}^* = 1 \) in poor country.
Note: \( y(t)^* = \ddot{y}^* \cdot A(t)^* = \ddot{y}^* \cdot A(0)^* \cdot e^{g \cdot t} \)
Problem 8.1C. Reduce population growth, increase saving. For example, increase public saving by reducing the budget deficit.

Answer: Problem 8.2: Capital share of GDP is about 30 percent implies that \( Y = K^{0.3} \cdot (A(t)L(t))^{(1-0.3)=0.7} \Rightarrow \ddot{y} = \tilde{k}^{0.3} \).
If the economy is in its steady state: The growth rate of output = \( n + g \), which is assumed to equal 0.03. The depreciation rate is 0.04.

Answer: Problem 8.2A: In the steady state: \( s \dot{y} = (n + g + \delta) \cdot (\dot{k}) \Rightarrow \\
\dot{s} = (n + g + \delta) \cdot (\dot{k} / \dot{y}) = (0.03 + 0.04)(2.5) = 0.175 \)
Answer: Problem 8.3B. \( MPK = \alpha \cdot K^\alpha \cdot (A \cdot L)^{1-\alpha} = \alpha \cdot (Y / K) = \frac{\alpha}{K / Y} = 0.3 / 2.5 = 0.12 \)
C. At the golden rule steady state: \( MPK = (n + g + \delta) = 0.03 + 0.04 = 0.07 \)

Thus, we need to increase \( \tilde{k} \) to achieve the golden rule steady state.

D. \( K / Y = \frac{\alpha}{MPK} = 0.3 / 0.07 = 4.29 \)
E. \( s = (n + g + \delta) \cdot (\dot{k} / \dot{y}) = (0.03 + 0.04)(4.29) = 0.3 \)
Answer: Problem 8.3: A. In the steady state: \( s\hat{y} = (n + g + \delta) \cdot (\hat{k}) \Rightarrow \hat{k} / \hat{y} = s / (n + g + \delta) \), which is constant because \( s, n, g, \) and \( d \) are constants.

As \( \hat{k} / \hat{y} = K / AL / Y / AL = K / Y \), we conclude that also \( K / Y \) is constant in the steady state.

B. Capital’s share of income = \( MPK \cdot K / Y = \alpha \cdot (Y / K) \cdot K / Y = \alpha \) Since capital’s share of income is constant (=\( \alpha \)), also labor’s share of income is constant = 1-\( \alpha \).

C. We know that in the steady state, the growth rate of \( Y \) is \( n + g \). In B. we showed that capital’s and labor’s share of income is constant. If the shares are constant, and total income grows at the rate \( n + g \), then labor income and capital income must also grow at the rate \( n + g \).

D. \( R / P = r + \delta = MPK = \alpha \cdot K^{\alpha-1} (A \cdot L)^{1-\alpha} = \alpha \cdot \tilde{k}^{\alpha-1} \)

The real rental price is constant in the steady state since \( \tilde{k} \) is constant in the steady state.

\( real \ wage = MPL = (1-\alpha)K^{\alpha} L^{-\alpha} A^{1-\alpha} = (1-\alpha)\tilde{k}^{\alpha} (t) A(t) = (1-\alpha)\tilde{k}^{\alpha} (t) A(0) e^{\epsilon t} \).

The real wage increases at the rate of technological progress: \( g \).

Answer: Problem 8.5: Country with a lot of education has a higher \( A(0) \) than the country with little education.

We assume that differences in educational level only impacts the level of technology and not the growth rate of technology: \( g \).

A. In the steady state, the growth rate of output is \( n + g \) which is the same for both countries.

B. In the steady state: \( y(t) = \hat{y} \cdot A(t) = \hat{y} \cdot A(0) \cdot e^{g t} \). As \( A(0) \) is higher in the country with a higher education, the level of income per worker is higher in this country. \( \hat{y} \) are the same in both countries as \( s, n, g, \) and \( d \) are identical in the two countries.

C. In the steady state: \( R / P = \alpha \cdot \tilde{k}^{\alpha-1} \) are the same in both countries as \( \tilde{k} \) are the same in both countries as \( s, n, g, \) and \( d \) are identical in the two countries.

D. \( real \ wage = MPL = (1-\alpha)\tilde{k}^{\alpha} (t) A(0) e^{\epsilon t} \) is higher in country with a lot of education as \( A(0) \) is higher in this country.