

ECON 311 - Intermediate Macroeconomics (Professor Gordon)

Final Examination: Winter 2019

YOUR NAME: _____

Net ID: _____

INSTRUCTIONS:

1. The exam lasts **2 hours**.
 2. The exam is worth 120 points in total (plus up to 4 time points): 45 points for the multiple choice questions (Part A), 75 points for the analytical problems (Part B).
 3. **Multiple choice:** choose the **one** alternative that best completes the statement or answers the question. **Write your answers for part A (the multiple choice section) in the blanks to the right.** You won't get credit for circled answers in the multiple choice section.
 4. **Place all of your answers for part B in the space provided.**
 5. You must show your work for part B questions. There is no need to explain your answers for the multiple choice questions.
 6. **You must turn in both the answers and the multiple-choice questions. DO NOT PULL THEM APART.**
- Good luck!

PART A: Multiple Choice Problems

Answer multiple choice questions in the space provided below. **USE CAPITAL LETTERS.**

1		11		21		31		41	
2		12		22		32		42	
3		13		23		33		43	
4		14		24		34		44	
5		15		25		35		45	
6		16		26		36			
7		17		27		37			
8		18		28		38			
9		19		29		39			
10		20		30		40			

PART B: Analytic Problems

QUESTION 1: Growth Rates (14 points)

The following table summarizes nominal GDP and the GDP growth rate for two countries A and B in 2018:

	GDP	GDP growth rate (annual)
Country A	1200	1%
Country B	800	1.5%

(a) If both countries continue to grow at the same rate, which country will first reach a GDP level of at least 2400? (4 points)

To reach a level of 3000, country A has to double its GDP while country B has to triple the GDP.

Doubling time

country A: $\ln 2 / 0.01 = 69.3$ years

Tripling time country

B: $\ln 3 / 0.015 = 73.2$ years \rightarrow Country A

(b) Now in addition to the data from part (a) assume that real GDP in country A in 2018 using 2015 as base year was 1000. Using the GDP Deflator, what was the average annual inflation rate between 2015 and 2018 in Country A? (4 Points)

GDP Deflator in 2018: $1200/1000 = 1.2$

Growth rate

between 2015 and 2018: $\ln(1.2/1) = 0.182 = 18.2\%$

Annualized growth rate = $18.2\%/3 = 6.07\%$

(c) In addition, you know that nominal GDP in 2015 for country A was 800. Using all available information, calculate the average annual growth rate of real GDP of country A between 2015 and 2018. (3 Points)

Annual Growth rate of real GDP = $100 * \ln(1000/800)/3 = 7.44$

(d) Finally, assume that economy of country A will grow at the annual rate of 1 percent starting from the year 2019 and onwards. How long will it take for country A to reach nominal GDP of 2000? (3 Points)

Years = $100 * \ln(2000/1200)/1 = 51.1$ Years

QUESTION 2: SP-DG Model (21 points):

Suppose that the following equations describe an economy currently at long-run equilibrium:

$$\begin{aligned} p_t &= p_t^e + 0.25 \cdot \widehat{Y}_t + z_t \\ p_t^e &= 0.4 \cdot p_{t-1}^e + 0.6 \cdot p_{t-1} \\ \widehat{Y}_0 &= 0, \widehat{x}_0 = 2, p_0^e = 2, p_0 = 2, z_0 = 0. \end{aligned}$$

(a) Write down the SP and DG equations using the information above. Substitute the DG equation into the numerical SP equation and solve for p_t as a function of p_{t-1} , p_{t-1}^e , \widehat{Y}_{t-1} , \widehat{x}_t , and z_t . (3 points)

SP	$p_t = 0.4 \cdot p_{t-1}^e + 0.6 \cdot p_{t-1} + 0.25 \cdot \widehat{Y}_t + z_t$
DG	$\widehat{Y}_t = \widehat{Y}_{t-1} + \widehat{x} - p_t$
p_t	$\begin{aligned} p_t &= 0.8 * (0.4 \cdot p_{t-1}^e + 0.6 \cdot p_{t-1} + 0.25 \cdot (\widehat{Y}_{t-1} + \widehat{x}) + z_t) = \\ &0.32 \cdot p_{t-1}^e + 0.48 \cdot p_{t-1} + 0.2 \cdot (\widehat{Y}_{t-1} + \widehat{x}) + 0.8z_t \end{aligned}$

(c) Starting in the long-run equilibrium described above in period 0, assume that in period $t=1$ we observe a temporary shock to z_t . In particular, $z_1 = 2$, $z_2 = 0$. Fill in the following table assuming that the central bank is following an **accommodating policy**. (3 points)

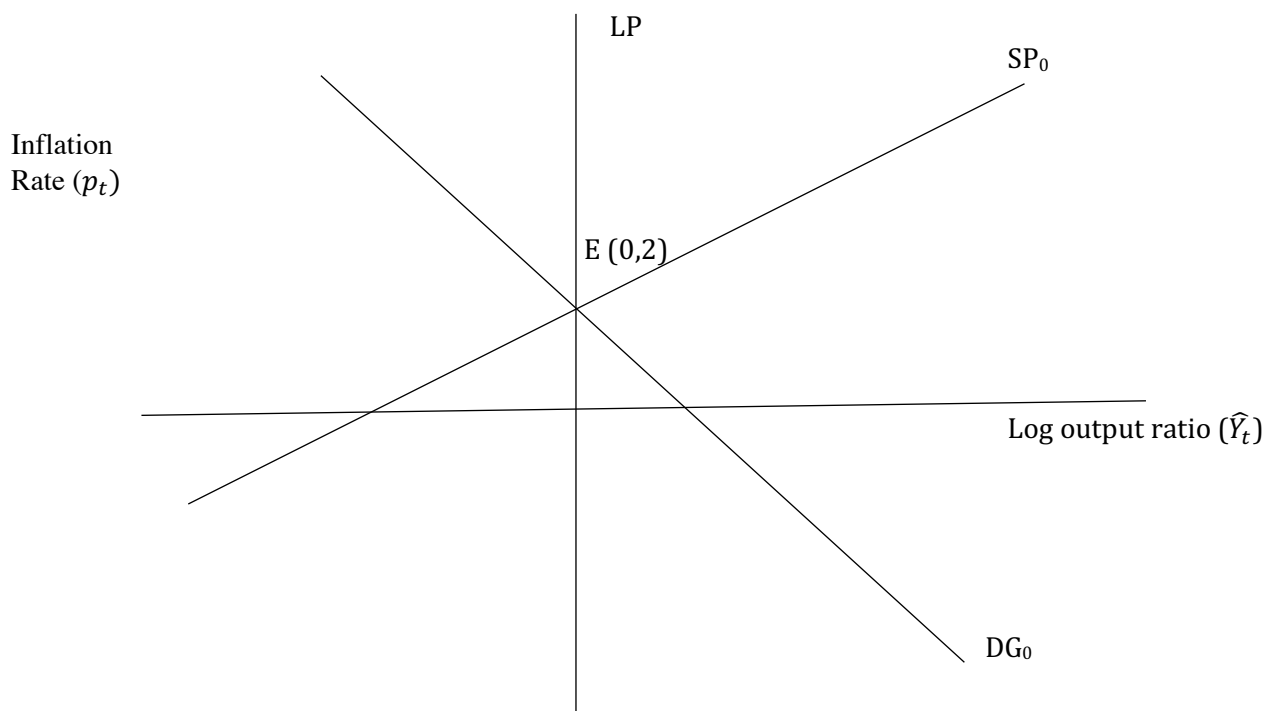
Plot period 1 SP and DG curves on the graph below, which illustrates period 0 economy with initial equilibrium at the point E. Indicate new equilibrium. (3 points)

t	p_t^e	\hat{Y}_t	\hat{x}_t	p_t	z_t
0	2	0	2	2	0
1	2	0	4	4	2

Accommodating policy: Y_t is constant. Hence,

$$\hat{x}_t = p_t$$

Simplify equation for the inflation and find p_t , then solve for output gap. For the graph, SP moves up by 2, DG to the right s.t. new equilibrium at the same output and higher inflation.

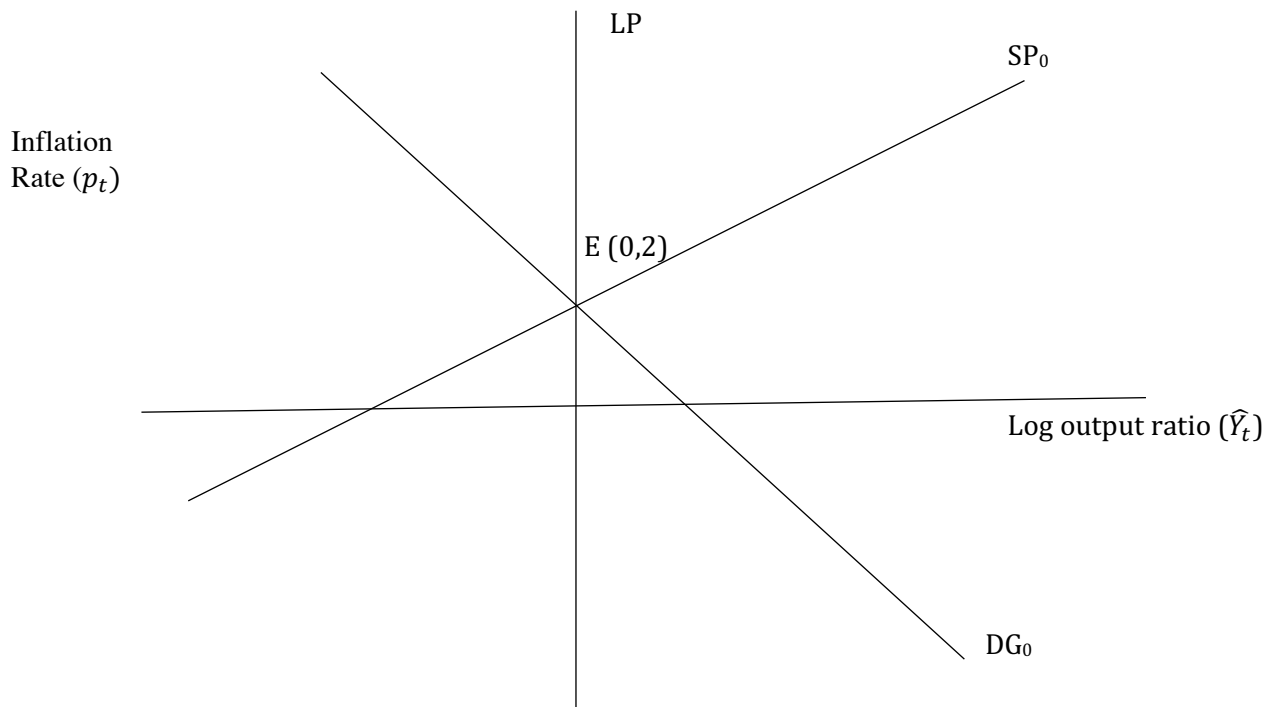


(d) Using the setting from part (c) but now assuming that the central bank is following a **neutral policy** fill in the following table assuming. (3 points)

Plot period 1 SP and DG curves on the graph below, which illustrates period 0 economy with initial equilibrium at the point E. Indicate new equilibrium. (3 points)

t	p_t^e	\hat{Y}_t	\hat{x}_t	p_t	z_t
0	2	0	2	2	0
1	2	-1.6	2	3.6	2

Neutral policy: \hat{x}_t is constant. Solve for the inflation (everything is known now), then for Output gap
 For the graph, SP moves up by 2, DG doesn't move s.t. new equilibrium at lower output and higher inflation.

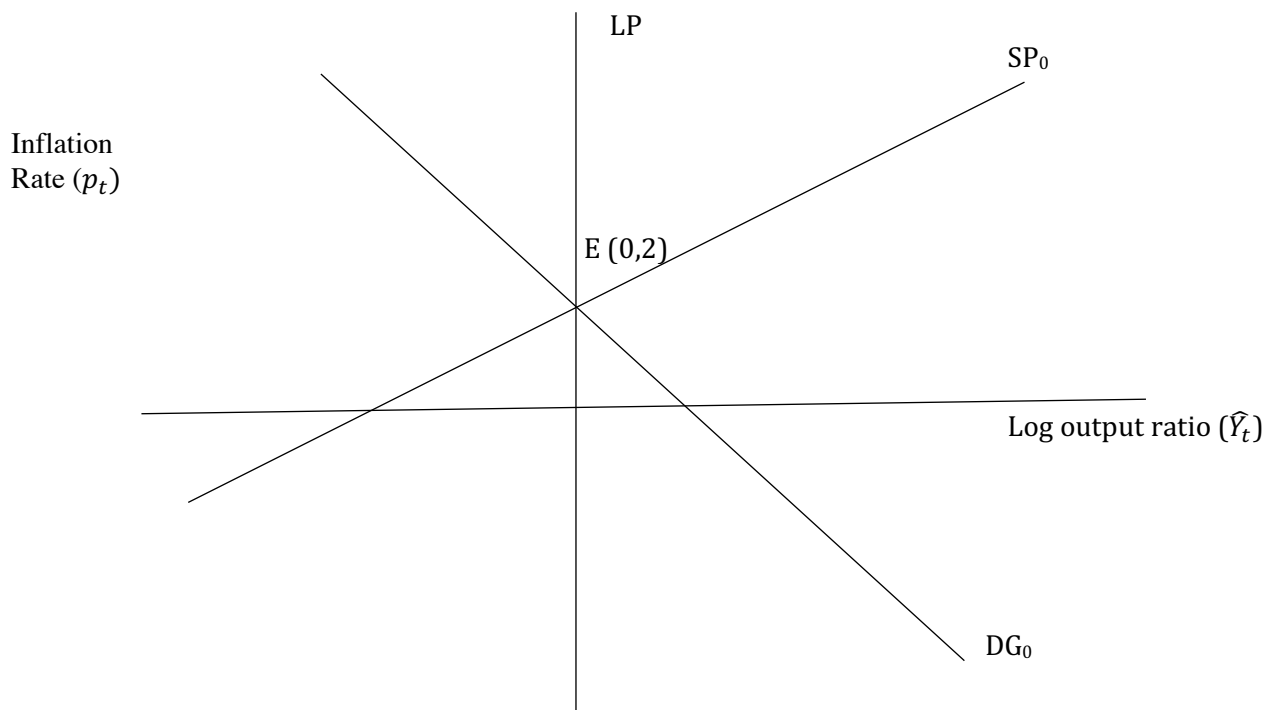


(e) Using the setting from part (c) but now assuming that the central bank is following **an extinguishing policy** fill in the following table assuming. (3 points)

Plot period 1 SP and DG curves on the graph below, which illustrates period 0 economy with initial equilibrium at the point E. Indicate new equilibrium. (3 points)

t	p_t^e	\hat{Y}_t	\hat{x}_t	p_t	z_t
0	2	0	2	2	0
1	2	-8	-6	2	2

*Extinguishing policy: p_t is constant and equal to expectations. Simplify inflation equation to express x_t in terms of known variables, solve for x_t and then find output gap.
For the graph, SP moves up by 2, DG moves to the left s.t. new equilibrium at much lower output, but the same inflation.*



QUESTION 3: Open Economy IS-LM (20 points)

Let the following equations describe a small open economy with perfect capital mobility and flexible exchange rate:

$$C = 70 + 0.6(Y - T),$$

$$T = 20$$

$$G = 40,$$

$$I^p = 60 - 6r,$$

$$NX = 50 - 0.1Y - 10e,$$

$$(M/P)^d = 0.2Y - 5r,$$

$$M^s/P = 45.$$

- (a) Assume that initially foreign and domestic interest rates are equal so that $r = r^f$ and that the exchange rate e is 4. Find the IS and LM equations. (4 points)

$$\text{The multiplier: } k = 1/(s(1-t) + t + nx) = 1/(0.4+0.1) = 1/0.5 = 2$$

$$\begin{aligned} \text{The IS equation is therefore: } Y &= k \cdot A_p(r) = k(C_a - cT_a + G + I_p(r) + NX_a) \\ &= 2 \cdot (70 - 0.6 \cdot 20 + 40 + 60 - 6r + 50 - 10e) \\ &= 336 - 12r \end{aligned}$$

$$\text{The LM equation is: } 45 = 0.2Y - 5r, Y = 225 + 25r$$

- (b) Find the equilibrium level of income and interest rate. (4 points)

$$\text{Use IS and LM to get: } r = 3, Y = 300.$$

- (c) The government decides to stimulate the economy by raising G by 37. What would be the effect on income and the interest rate if the economy was closed? (4 points)

$$A_p(r) \text{ goes up by } 37 \rightarrow E_p \text{ goes up by } 2 \cdot 37 \rightarrow$$

$$\text{The new IS equation is: } Y = 410 - 12r.$$

$$\text{Thus, the new equilibrium is } r=5, Y = 350.$$

- (d) Since this is a small open economy with a flexible exchange rate, something must change in order to restore interest rate parity between the domestic and foreign interest rates that you solved for in part (b). What is the variable that changes and in what direction? What is its new value? (4 points)

The higher domestic interest rate will attract foreign investment in the economy, driving up demand for the domestic currency. Thus, the domestic currency will appreciate, i.e. e will go up. The stronger currency hurts exporters and NX will decrease to exactly offset the fiscal stimulus. The model predicts that fiscal policy is ineffective in a small open economy with perfect capital mobility and flexible exchange rate.

$$e' = 4 + 3.7 = 7.7 \text{ to keep } Ap' \text{ constant}$$

- (e) Suppose now that the Central Bank in this economy is committed to an exchange rate peg of $e = 4$. Given the government stimulus, what action can the central bank take to restore interest rate parity while maintaining an exchange rate of $e = 4$? What is the new value for the variable modified by the central bank? (4 points)

The central bank can implement expansionary monetary policy to bring down the domestic interest rate. It increases real money supply.

With $e = 4$ and the government expansion, the IS curve is given by $Y = 410 - 12r$.

The world interest rate is $r^f = 3$. Putting this two together we get that output is $Y = 410 - 12(3) = 374$.

The LM curve as a function of (M^s/P) is: $Y = 5(M^s/P) + 25r$. We know that $r = 3$ and $Y = 374$. So we can solve for real money supply. $(M^s/P) = (374 - 25(3))/5 = 59.8$.

QUESTION 4: Solow Growth Model (20 points)

The aggregate production function in this economy is described by $Y = AK^b(E \cdot N)^{1-b}$, where Y and K denote total output and capital, while N corresponds to population and E is the efficiency of each worker. (Therefore, E·N denotes the effective number of workers.) The population grows at rate n and the efficiency of workers grows at rate e.

The capital stock decline over time due to depreciation at a rate d, and increases because of investment, I, in new capital. Investment equals a fraction s of output, and consumption corresponds to the remaining (1-s) fraction of output.

Assume the following parameter values: A = 1, b = 0.5, s = 0.35, n = 0.02, e = 0.02, d = 0.01.

(a) Derive the “per effective worker” production function. That is, the production function relating output per effective worker, $Y/(EN)$, to capital per effective worker K/EN . (3 points)

$$\frac{Y}{EN} = \frac{K^{0.5}(E \cdot N)^{0.5}}{EN} = \frac{K^{0.5}}{(E \cdot N)^{0.5}} = \left(\frac{K}{EN}\right)^{0.5}$$

(b) What will be the growth rate of the following variables in the long run steady state? (5 points)

Variable	Growth rate in steady state
Output per effective worker $\frac{Y}{EN}$	0
Output per worker $\frac{Y}{N}$	e=0.02
Total output Y	n+e = 0.04
Consumption per worker $\frac{C}{N}$	e = 0.02
Total consumption C	n+e = 0.04

(c) Derive the steady state level of capital per effective worker and output per effective worker. (4 points)

The steady state is given by $\Delta \frac{K}{EN} = 0$.

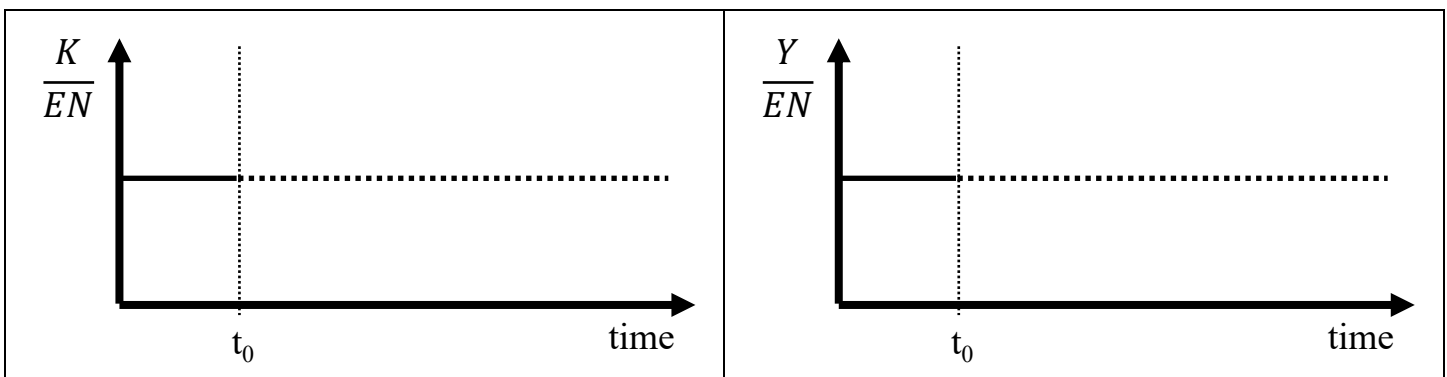
$$\begin{aligned} \Delta \frac{K}{EN} &= s \frac{Y}{EN} - (n + e + d) \frac{K}{EN} = 0 \\ s \left(\frac{K}{EN} \right)^{0.5} &= (n + e + d) \frac{K}{EN} \\ \frac{K}{EN} &= \left(\frac{s}{n + e + g} \right)^2 = 49 \\ \frac{Y}{EN} &= 7 \end{aligned}$$

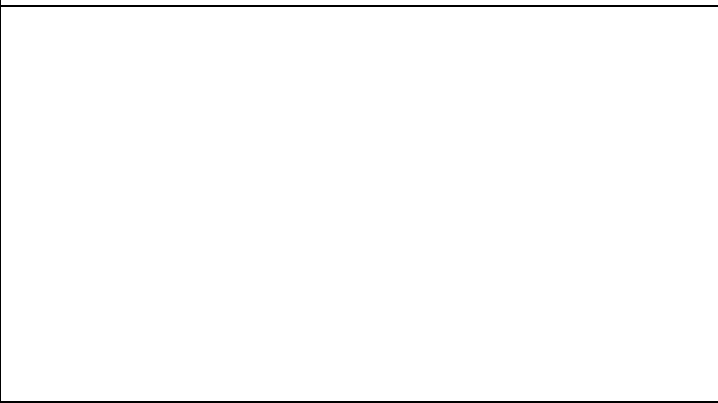
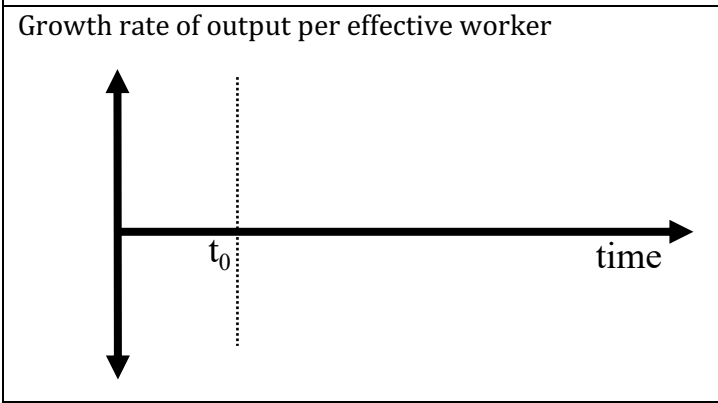
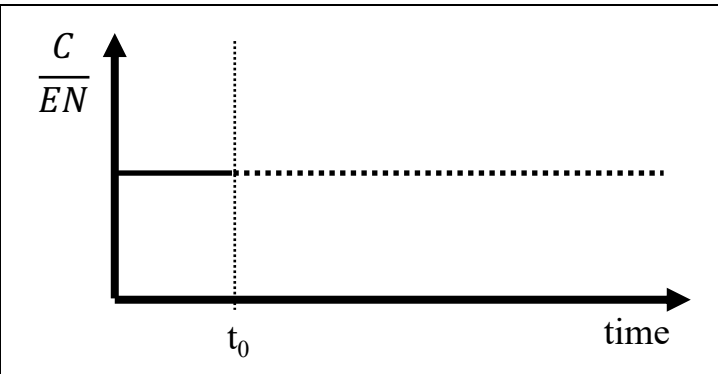
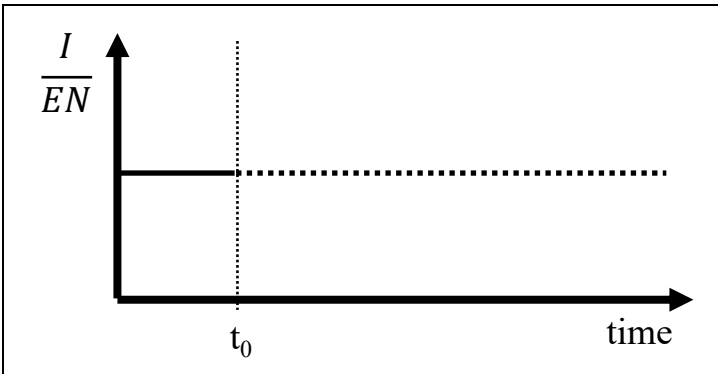
(d) Suppose that the economy experiences a permanent decline in the growth rate of technological progress, e . What would happen to the long-run level of capital per effective worker and output per effective worker? What would happen to the long-run growth rate of output per worker? (3 points)

Long run level of capital per effective worker will increase, as well as output per efficient worker.

Output per worker will grow at a lower rate.

(e) Go back to assumptions of part (a)-(c). The savings rate increases to $s = 0.50$. Draw the approximate paths of the level of capital, output, investment and consumption per effective worker (all of them per effective worker!) and the growth rate of output, during the transition between the initial steady state (that with $s = 0.35$) and the steady state associated with the new savings rate. (5 points)





PART A: Multiple Choice Questions

Choose the one alternative that best completes the statement or answers the question.

1) The short-run equilibrium of inflation and real GDP

- A) occurs where expected inflation equals actual inflation.
- B) depends only on the rate of growth of the money supply.
- C) depends only on the rate of growth of nominal GDP.

D) None of these.

2) In 1991, the growth rate of nominal GDP was 2.97 percent and the growth rate of real GDP was -0.98 percent. The inflation rate was

- A) 2.91 percent.
- B) 1.99 percent.
- C) 2.97 percent.

D) 3.95 percent.

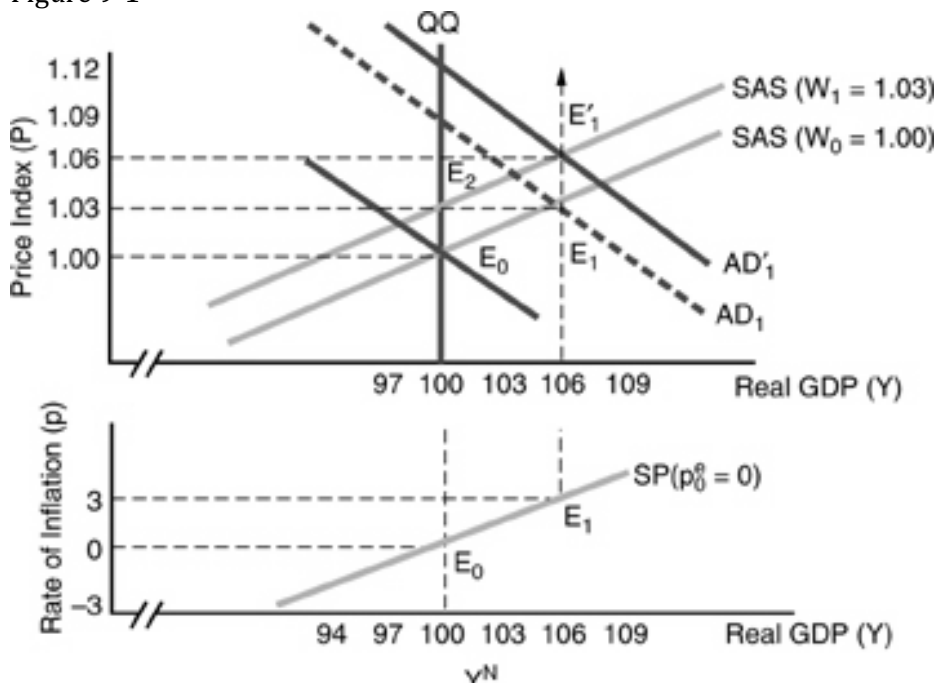
3) If nominal GDP growth in an economy is a constant 7 percent, the economy's long-run equilibrium is at Y equal to _____ with inflation of _____.

- A) 103.5, 3.5 percent
- B) 107, zero
- C) 100, zero

D) 100, 7 percent

E) 107, 7 percent

Figure 9-1



4) Everywhere to the left of the long-run Phillips Curve as in Figure 9-1 above

A) actual inflation is less than expected inflation and the expected inflation rate will be reduced.

B) actual inflation is greater than expected inflation and the expected inflation rate will be raised.

C) actual inflation is less than expected inflation and the expected inflation rate will be raised.

D) actual inflation is greater than expected inflation and the expected inflation rate will be reduced.

5) Many extended periods of high actual unemployment above the natural rate have been the result of

A) high job turnover.

- B) unemployment compensation.
- C) mismatches in the labor market.
- D) deliberate government anti-inflationary policy.**

6) When the economy is near the natural unemployment rate, most adult males looking for work are experiencing _____ unemployment.

- A) turnover
- B) seasonally
- C) cyclically
- D) mismatch**

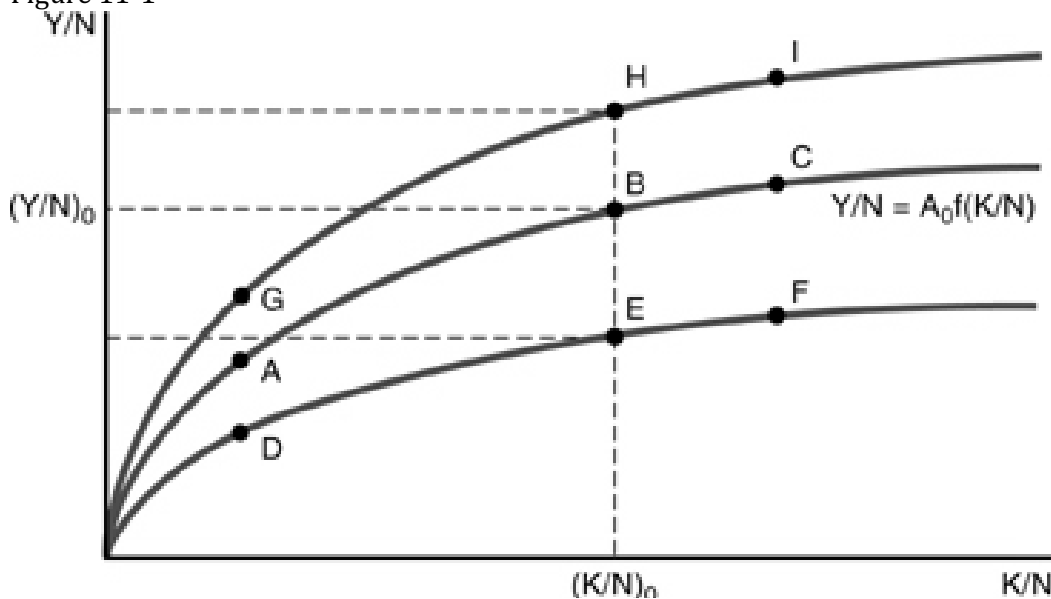
7) Who among the following is NOT frictionally unemployed?

- A) Diana, who has quit her job and is now looking for another
- B) Andrew, a teenager who has just entered the labor market looking for his first part-time job
- C) Barbara, who is re-entering the labor market after a divorce
- D) Charles, who was laid off from his factory job but expects to be recalled in a few weeks**

8) Holding the actual unemployment rate below the natural unemployment rate eventually causes the natural rate to fall toward the actual, according to the _____ hypothesis, implying that an aggressive stimulative demand policy causes a _____ acceleration of inflation.

- A) hysteresis, temporary**
- B) structuralist, permanent
- C) hysteresis, permanent
- D) structuralist, temporary

Figure 11-1



9) Initially, the economy is at point B on Figure 11-1 above. According to the Solow growth model, an increase in the output per capita without an increase in capital per worker is represented by _____ and could be the result of _____.

- A) the movement B to F; a decrease in the savings rate
- B) the movement B to E; new technology discoveries
- C) the movement B to C; an increase in the savings rate
- D) the movement B to H; improved health and education per worker**

10) One of the shortcomings of the Solow growth model is that in it the rate of technological change is

- A) assumed to be zero.

B) left unexplained.

C) assumed to be equal to the population growth rate.

D) zero unless the saving rate exceeds the depreciation rate.

11) Suppose that the government passes a law requiring households to increase savings 10% above previous levels. According to Solow's growth theory, in the long run

A) output per capita grows at the constant steady state rate, n .

B) output per capita stays constant.

C) output per capita grows more rapidly.

D) None of the above.

12) In Chapter 11, the variable N can be regarded as total population, workers, work-hours, or "effective" work-hours, all proxies for each other if they are assumed to grow at the same rate. To define (Y/N) as the standard of living, N is particularly regarded as

A) work-hours.

B) "effective" work-hours.

C) total population.

D) workers.

13) The principle of compound interest insures that

A) a small difference in the per capita GDP growth rate between countries in one year will grow to a large difference in the long run.

B) a small difference in the per capita GDP between countries in one year will grow to a large difference in the long run.

C) U.S. interests are compounded by the interests of all other countries.

D) U.S. interests are compounded by the interests of Great Britain and Germany.

14) If it is assumed that capital is alike and freely mobile between economies, the Solow growth model

A) suffers from the "exogeneity" problem.

B) has no need of the recent attempts at improving it.

C) suffers from the "non-convergence" problem.

D) suffers from the "incentives" problem.

15) What type of economic conditions are summarized by the variable a ?

A) changes in labor productivity

B) technological change

C) changes in capital productivity

D) All of the above

16) What is the growth rate of multifactor productivity if $b = 0.20$, $k = 3$, $n = 1$, and $y = 4$?

A) 2.8

B) 0.4

C) 2.6

D) 1.0

17) Relative to the United States, Europe has

A) faster job growth.

B) caught up in growth of labor productivity.

C) caught up in output per capita.

D) all of the above.

18) Which of the following is NOT an exogenous factor affecting economic growth that countries caught in a "poverty trap" might utilize to encourage economic growth?

- A) infrastructure
- B) geographical location
- C) human capital**
- D) political capital

19) The Solow model predicts that the standard of living in poorer nations will converge on that of richer nations through rapid capital formation that raises output per person. The introduction of technological change to the model _____ change this prediction because technology _____ assumed to be freely available to all countries.

- A) does not, is**
- B) does not, is not
- C) does, is
- D) does, is not

20) The key prediction of the Solow model adapted to include technological change _____ been born out, i.e. with a few exceptions convergence _____ a reality.

- A) has not, is
- B) has, is not
- C) has, is
- D) has not, is not**

21) Which of the following is a reason why central banks might allow excessive money growth?

- A) temptation of supply contraction
- B) fear of excess job growth
- C) adverse supply shocks**
- D) increasing government surpluses by printing money

22) Unanticipated deflation unambiguously hurts:

- A) importers
- B) exporters
- C) creditors
- D) debtors**

23) Which of the following is a necessary condition for inflation to be harmless?

- A) Only real (not nominal) interest income is taxable**
- B) Only nominal (not real) cost of borrowing is tax deductible
- C) Both of the above
- D) None of the above

24) A policy that provides subsidies for firms to train workers is likely to reduce which type of unemployment?

- A) Turnover
- B) Mismatch**
- C) Cyclical
- D) Informal labor market

25) Unlike the IS-LM model, the Solow model assumes:

- A) Continuous business cycles and sticky prices
- B) Continuous business cycles and flexible prices
- C) Continuous full employment and sticky prices
- D) Continuous full employment and flexible prices**

26) One reason why U.S. growth in real income per capita is likely to be lower in the decades to come than in 1987-2007 is:

- A) The high cost of college education is hindering human capital creation**
- B) The baby boom generation will exit retirement to rejoin the workforce
- C) The lingering effects of the Volcker disinflation
- D) The Federal Reserve's efforts to stabilize real income per capita growth at 2%

27) Fiscal policy in a large open economy with imperfect capital mobility and fixed exchange rates is:

- A) illegal under WTO rules
- B) impotent
- C) strong, and stronger than in small open economy
- D) strong, but not as strong as in small open economy**

28) Which provides the best estimate of expected inflation?

- A) The 10-year Treasury bond rate minus the TIPS bond rate**
- B) The TIPS bond rate minus the federal funds rate
- C) The corporate Baa bond rate minus the TIPS bond rate
- D) The corporate Baa bond rate minus the 10-year Treasury bond rate

29) If the Federal Reserve buys 10-year U.S. Treasuries as a part of quantitative easing, it is trying to reduce the:

- A) term premium**
- B) inflation premium
- C) risk premium
- D) exchange rate premium

30) Compared to 2008, the Federal Reserve's balance sheet in 2018:

- A) became smaller
- B) became larger**
- C) had a larger difference in assets minus liabilities
- D) had a larger difference in liabilities minus assets

31) Suppose that the U.S. develops an innovative product that other countries start to import. Then the dollar may appreciate without changing the _____, which could cause a breakdown in _____.

- A) productivity differential; PPP
- B) productivity differential; the structuralist hypothesis
- C) inflation differential; PPP**
- D) inflation differential; the structuralist hypothesis

32) From 1980 to 2018, official foreign holdings of U.S. dollar reserves as a share of U.S. GDP have:

- A) stayed constant
- B) grown**
- C) fallen
- D) become unreliable due to counterfeiting

33) A central goal of many central banks, including the U.S. Federal Reserve, is to:

- A) control inflation**
- B) keep a stable level of real GDP per capita
- C) keep a stable nominal GDP growth rate
- D) maximize profits for shareholders

34) In 1971 President Nixon introduced price controls. This was equivalent to a

- A) positive demand shock
- B) negative demand shock
- C) beneficial supply shock**
- D) adverse supply shock

35) U.S. total factor productivity growth was fastest during

- A) 1890-1920
- B) 1920-1970**
- C) 1970-2018
- D) Same in all three periods

36) Which of the following is NOT true as a result of the invention of ATM cash machines in the early 1970s?

- A) cash is available day and night
- B) employment of bank tellers fell by two-thirds**
- C) employment of bank tellers doubled
- D) people obtain cash more often

37) Which of the following job categories declined the most following the invention of spreadsheets in the early 1980s?

- A) auditors
- B) management analysts
- C) bookkeepers**
- D) financial managers

38) Which was the time interval when growth in hours of work was boosted by the entry of women into the labor force?

- A) 1925-55
- B) 1945-75
- C) 1965-95**
- D) 1985-2005

39) The Federal Reserve Chairperson most associated with anti-inflationary policies is

- A) Paul Volcker**
- B) Alan Greenspan
- C) Ben Bernanke
- D) Janet Yellen

40) The long article at the end of the course packet ("Missing the Juice") proposed five categories of explanations for the slowdown in U.S. productivity growth. Which is not among these five categories?

- A) It's the labor force
- B) It's the government
- C) It's the one percent
- D) It's the measurement**
- E) It's the companies

41) The article on the "Cost of Innovation" contrasts

- A) rising total factor productivity growth with a declining number of research workers
- B) constant total factor productivity growth with a rising number of research workers
- C) declining total factor productivity growth with a rising number of research workers**
- D) constant total factor productivity growth with a declining number of research workers

42) Compared to the U.S., in a recession unemployed European workers receive

- A) higher unemployment benefits as a percentage of salary but for a shorter amount of time
- B) higher unemployment benefits as a percentage of salary and for a longer amount of time**
- C) lower unemployment benefits as a percentage of salary and for a shorter amount of time
- D) lower unemployment benefits as a percentage of salary but for a longer amount of time

43) Compared to 1970-2000, the behavior of inflation and unemployment since 2000 suggest that the SP line (drawn with inflation on the vertical axis and unemployment on the horizontal axis) has

- A) become steeper
- B) become flatter**
- C) become vertical
- D) become positively sloped

44) The Big Mac index described in the course packet shows that the U.S. dollar compared to Switzerland and Norway is

- A) undervalued**
- B) overvalued
- C) equally valued
- D) no comparison is possible

45) The “exorbitant privilege” refers to all of the following but which one?

- A) U.S. buys imports and pays when foreign central banks buy U.S. government debt
- B) Foreigners buy U.S. exports and pay in U.S. dollars**
- C) Foreign central banks hold reserves in U.S. dollars
- D) U.S. net inflow of goods is matched by a net outflow of stocks, bonds, and other financial assets