

Lecture 1 Overview & Introduction

Biwei Chen
(Updated: January 24)

Reference: Mankiw, 2019, Macroeconomics, CH1 The Science of Macroeconomics

I. Analytical Framework

1. Definition: the study of the overall economy. How is our economy doing?
2. Why study it? “Macroeconomists attempt to explain the economy and to devise policies to improve its performance.” 1) understand the economy; 2) make good decisions; 3) change the surroundings; 4) public policy concerns.
3. Topics: National output, inflation, unemployment, economic growth and fluctuation, government budgets, money and banking, financial system, fiscal and monetary policies.
4. Theory: 1) classical theory (price/money/interest); 2) growth theory; 3) business cycle theory.
5. Macroeconomics in one equation: $MV=PY$ (quantity equation of money). Each variable is unobservable and requires measurement techniques and statistical procedures.
 - 1) Y – output level; (long run growth, short run fluctuations; labor and unemployment)
 - 2) P – price level; (inflation, which affects production, consumption, investment, savings)
 - 3) M – quantity of money in transaction; (money and banking, monetary policy)
 - 4) V – transaction velocity; (demand for money, payment technology)
6. Macroeconomic variables: 1) stock v.s. flow. Identify the following pairs: income and wealth; capital and investment; deficit and debt; price level and inflation; 2) nominal v.s. real. (PQ v.s. Q).

II. Scientific Methodology

1. Macroeconomic phenomena (facts, observations, data)
2. Theories and models (for the purpose of explanation and prediction)
3. Empirical evidence to test the theory (statistical and econometric methods)
4. Theory evaluation: Reject/refine a theory or develop a new theory (mathematics)

III. Macro Data and Statistics

1. National income: GDP, GNP
2. Price level: CPI, PCE, GDP deflator
3. Unemployment (measures labor market condition): UR, ER, LFPR, EtoP
4. Money stocks: MB, M1 and M2; Federal Funds Rate (riskless interest rate).
5. Data frequency; seasonality; smoothing and moving average; indexing.
6. New York Fed (FRBNY) - U.S. Economy in a Snapshot
7. Federal Reserve Board - Economic Projections to be released with the FOMC minutes
<https://fred.stlouisfed.org/release/tables?rid=326&eid=783029>
<https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm>

IV. Theories and Models

1. Definition: an abstraction and simplification of reality.
2. Functions: 1) explanation; 2) forecast; 3) policy implication.
3. Components: 1) postulates and assumptions; 2) variables of interest; 3) relations and outcomes.
4. Demand and supply model. 1) the law of demand and supply; 2) endogenous variables; 3) exogenous variables; 4) equilibrium and new equilibrium; 5) graphs; 6) solutions; 7) shocks.
5. Key assumptions in macroeconomics: 1) short-run price stickiness; 2) long-run price flexibility.

Readings

U.S. Economy in a Snapshot <https://www.newyorkfed.org/research/snapshot>

IMF: 5 Charts That Explain the Global Economy in 2018

<https://blogs.imf.org/2018/12/20/5-charts-that-explain-the-global-economy-in-2018/>

20190116 The real threat the government shutdown poses for the American economy

<https://www.brookings.edu/blog/fixgov/2019/01/16/the-real-threat-the-government-shutdown-poses-for-the-american-economy/>

A Summary of the 2019 Economic Report of the President

<https://www.whitehouse.gov/articles/summary-2019-economic-report-president/>

Keynesian Economics by Alan Blinder

<https://www.econlib.org/library/Enc/KeynesianEconomics.html>

New Classical Macroeconomics by Kevin D. Hoover

<https://www.econlib.org/library/Enc/NewClassicalMacroeconomics.html>

New Keynesian Economics by N. Gregory Mankiw

<https://www.econlib.org/library/Enc/NewKeynesianEconomics.html>

Schools of Economic Thought

<https://www.econlib.org/cee-by-category/?category=schools-of-economic-thought#schools-of-economic-thought>

Milton Friedman "The Methodology of Positive Economics" In Essays in Positive Economics (Chicago: Univ. of Chicago Press, 1966), pp. 3-16, 30-43.

FRED Economic Blog <https://fredblog.stlouisfed.org>

Economic Data Basics <https://www.dallasfed.org/research/basics/>

FedViews Economic Outlook <https://www.frbsf.org/economic-research/publications/fedviews/>

Emi Nakamura, Clark Medalist 2019 (price rigidity and adjustment)

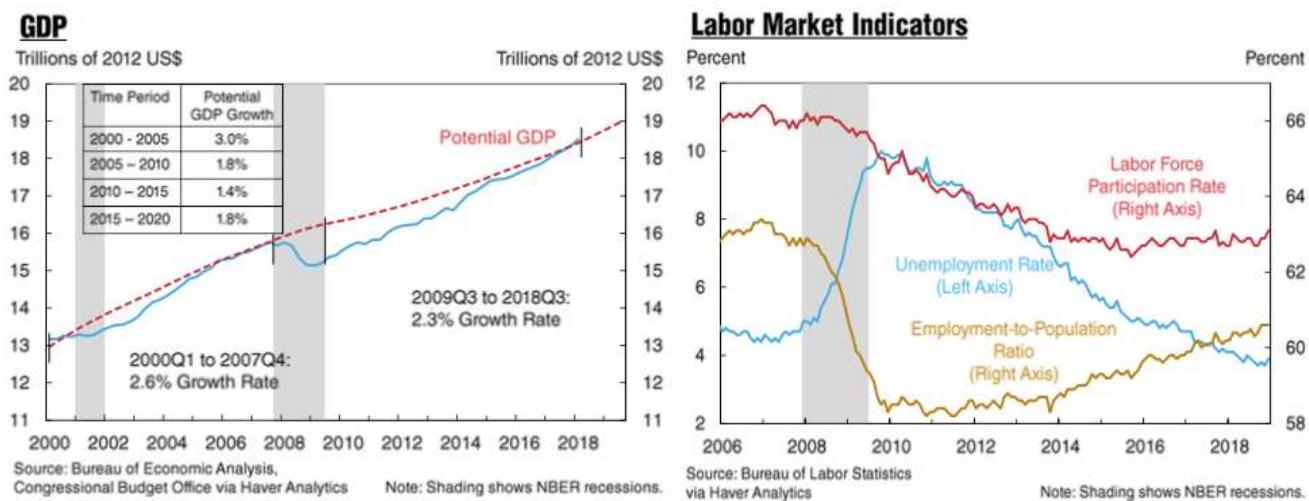
<https://www.aeaweb.org/about-aea/honors-awards/bates-clark/emi-nakamura>

Lecture 2 Measurements in Macroeconomics

Biwei Chen
 (Updated: February 9)

Reference: Mankiw, 2019, Macroeconomics, CH2 The Science of Macroeconomics

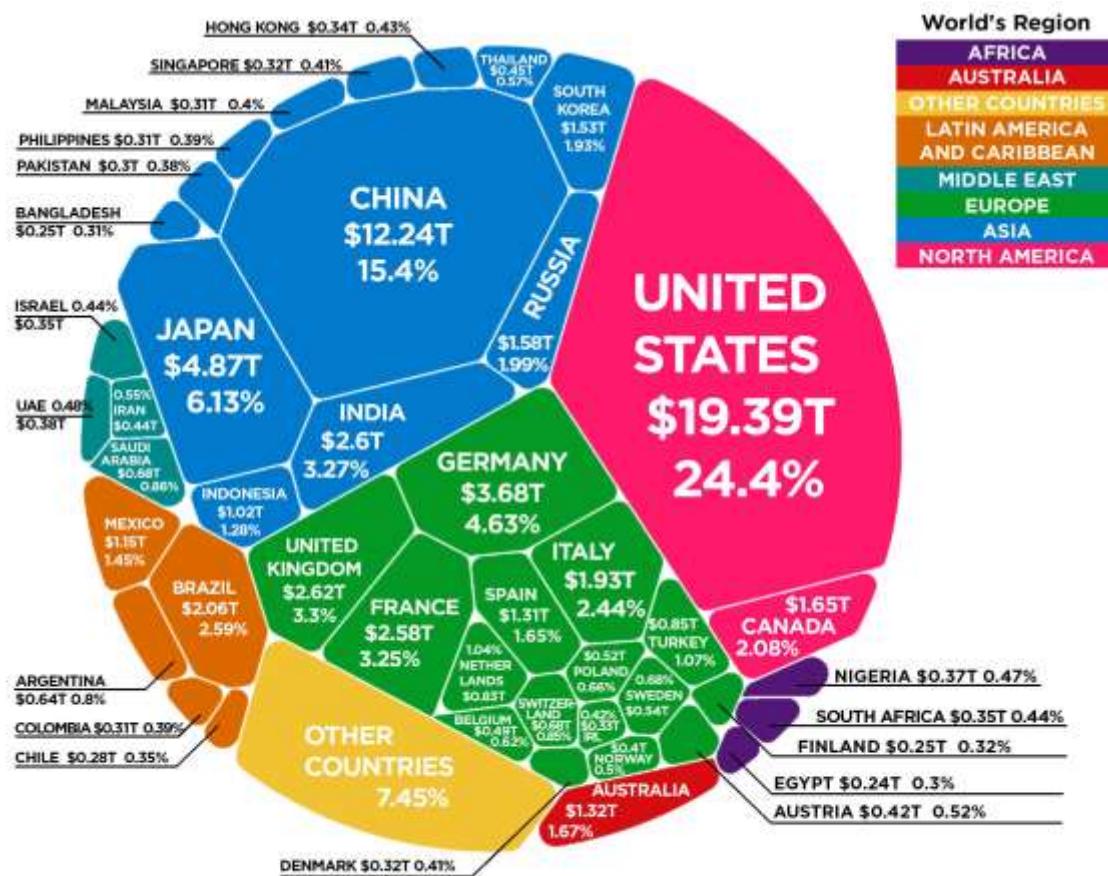
In this lecture, we will learn the methods and techniques for measuring key macroeconomic variables behind the quantity theory of money $MV=PQ$. In particular, the national income, unemployment, and price level. Data: <https://www.newyorkfed.org/research/snapshot/index.html>



I. National Income

1. Gross Domestic Product: the total market value of all the goods and services produced within a country in a given period. 1) market value; 2) final goods; 3) within a country; 4) in one period.
2. Nominal GDP v.s. Real GDP. Which is a better measure? Answer: RGDP. NGDP is a product of P and Q, measured in term of market prices. However, price level can vary over time. In a period of rapid price increase, the NGDP will be inflated and will not reflect the true size of the economy. Therefore, economists need to isolate the effect from price change in order to measure GDP.
3. Nominal GDP = $P \times Q$ = current year price * current year output
4. Real GDP = $BP \times Q$ = base year price * current year output
5. Technique: Index. Economists measure total output in one number for both NGDP and RGDP (why?). If the prices do not change over time (isolating the price effect), then the change in the value of GDP is solely coming from the change in quantity of goods and services.
6. Example: 2017, $Q_a=2$, $P_a=\$1$, $Q_b=5$, $P_b=\$0.4$; 2018, $Q_a=3$, $P_a=\$1$, $Q_b=8$, $P_b=\$0.5$; GDP?
7. GDP applications: 1) measure economic size and development www.gapminder.org/tools/
 2) project economic growth; 3) international comparison and country classification; 4) impute inflation rate (GDP deflator method).

8. Three approaches to measuring GDP: 1) product approach; 2) income approach (wage, rent, interest, profit); 3) expenditure approach. They shall provide similar numbers up to certain statistical discrepancies.
9. Expenditure components: $Y=C+I+G+NX$. Income equal expenditure. Why is NX part of it?
 - 1) C-Consumption: individual or household's expenditures except new housing construction
 - 2) I-Investment: business sector adding to the physical stock of capital, including inventories
 - 3) G-Government spending: including national defense, public infrastructure, government employees' salaries, public education and research, foreign aid. Transfer payments (social security and unemployment benefits) are not counted as part of GDP because transfers are not part of current production. $G-T>0$, budget deficit; $T-G>0$, budget surplus. $T=G$ balance.
 - 4) NX-Net export. Trade balance. $NX>0$, trade surplus; $NX<0$, trade deficit.
10. GDP vs GNP. 1) Gross National Product: a nationality measure, earned by the nation's production factors, including factors abroad. 2) table on slide p.25; 3) What is the difference between them?



Article and Sources:
<https://howmuch.net/articles/the-world-economy-2017>
<http://databank.worldbank.org/data/download/GDP.pdf>

howmuch.net

II. Labor Market Conditions

The U.S. Bureau of Labor Statistics calculates the unemployment rate and other statistics that economists and policymakers use to gauge the state of the labor market. These statistics are based on results from the Current Population Survey of about 60,000 households that the Bureau performs each month. The survey provides estimates of the number of people in the adult population (16 years and older) who are classified as either employed, unemployed, or not in the labor force.

1. Population categories ($POP=LF+NLF$)

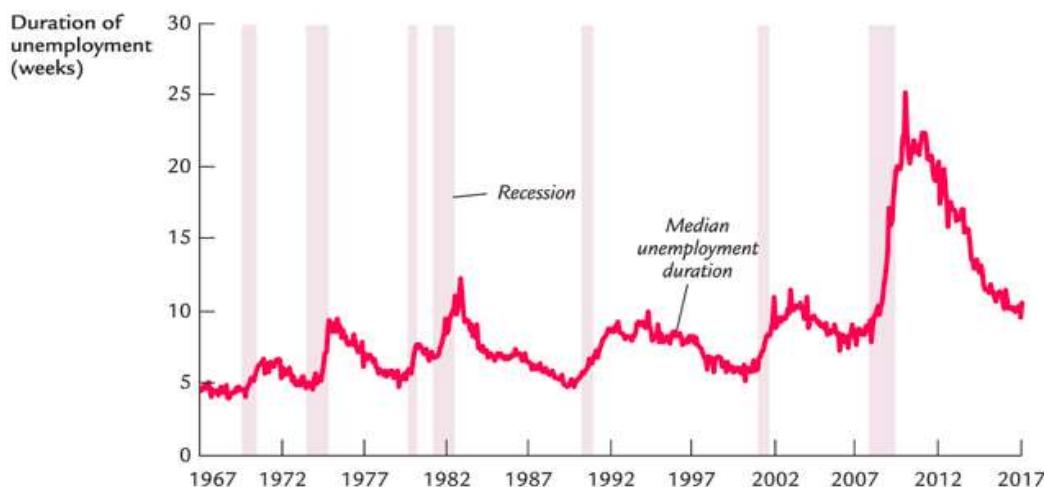
- 1) E-Employed: working at a paid job; U-Unemployed: not employed but looking for a job
- 2) LF-Labor force: $LF=E+U$; Not in LF: not employed, not looking for work

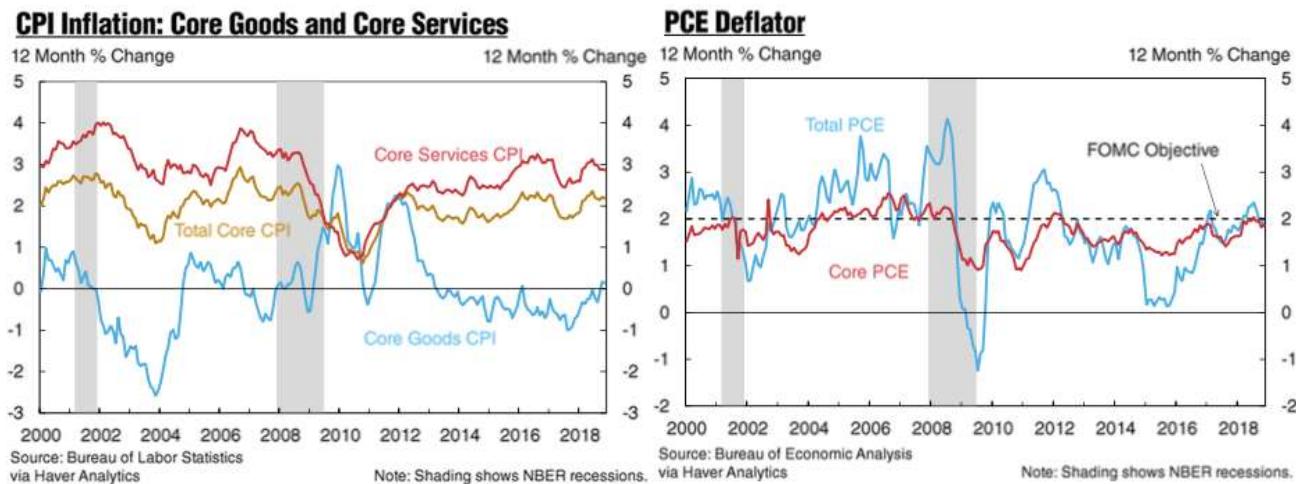
2. Key indicators: UR, LFPR, EPR

- 1) UR-Unemployment rate= $U/E+U=U/LF$
- 2) LFPR-Labor force participation rate= LF/POP
- 3) EPR-Employment to population ratio= E/POP

Variable	Description	Rate
U-1	Persons unemployed 15 weeks or longer, as a percent of the civilian labor force (includes only very long-term unemployed)	1.7
U-2	Job losers and persons who have completed temporary jobs, as a percent of the civilian labor force (excludes job leavers)	2.1
U-3	Total unemployed, as a percent of the civilian labor force (official unemployment rate)	4.3
U-4	Total unemployed, plus discouraged workers, as a percent of the civilian labor force plus discouraged workers	4.7
U-5	Total unemployed plus all marginally attached workers, as a percent of the civilian labor force plus all marginally attached workers	5.3
U-6	Total unemployed, plus all marginally attached workers, plus total employed part time for economic reasons, as a percent of the civilian labor force plus all marginally attached workers	8.6

3. Discouraged workers: workers who have given up on looking for a job and are considered out of the labor force. Marginally attached workers: persons *not* in the labor force who want and are available for work and who have looked for a job but have not recently looked for work.





III. Price Level and Inflation

1. How do economists measure the aggregate price level? More importantly, the change in price level over time. Ans: choose a basket of goods and services representing the economy.
2. Consumer Price Index – CPI: a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. <https://www.bls.gov/cpi/> <https://www.bls.gov/cpi/questions-and-answers.htm#>
3. Measurement techniques. Choose a basket of weighted goods and services and track its aggregate price over time. Since the basket is fixed, the change of the market value of that basket derives only from the change in prices. It's a monthly measure.
 - 1) Choose a basket in a particular month as the base month, calculate its total cost. Index it.
 - 2) Calculate the total cost of the basket in other months.
 - 3) $\text{CPI} = \text{current month basket cost}/\text{base year basket cost} = (\text{P} * \text{BQ})/(\text{PB} * \text{BQ})$.
 - 4) Inflation rate = percentage change in CPI from 12 months ago.
4. Example: 2017, $Q_a=2$, $P_a=\$1$, $Q_b=5$, $P_b=\$0.4$; 2018, $Q_a=3$, $P_a=\$1$, $Q_b=8$, $P_b=\$0.5$; CPI? IR?
5. Core-CPI. CPI excluding food and energy.
6. Personal Consumption Expenditure (PCE) and Core-PCE. Chain-type price index (changing basket). Federal Reserves' monetary policy target on inflation rate.
7. Measuring inflation via GDP deflator method: 1) $D_1 = \text{NGDP}_1/\text{RGDP}_1$; $D_2 = \text{NGDP}_2/\text{RGDP}_2$; 2) Inflation rate = $D_2 - D_1/D_1$. Idea: NGDP/RGDP measures the multiplication effect of price level in calculating real income. How many times is real GDP inflated by current year prices?

Readings

US GDP Statistics and How to Use Them

<https://www.thebalance.com/u-s-gdp-5-latest-statistics-and-how-to-use-them-3306041>

FRED-Graphing GDP components

<https://fredblog.stlouisfed.org/2014/11/graphing-gdp-components-with-our-new-release-view/>

Components of GDP Explained: Four Critical Drivers of America's Economy
<https://www.thebalance.com/components-of-gdp-explanation-formula-and-chart-3306015>

What is Counted in GDP?
<http://www.econport.org/content/handbook/NatIncAccount/Counted.html>

How Do Imports Affect GDP?
https://files.stlouisfed.org/files/htdocs/publications/page1-econ/2018/09/04/how-do-imports-affect-gdp_SE.pdf

Pitfalls in GDP Accounting
<https://www.econlib.org/library/Columns/y2016/Murphygdp.html>

What will succeed GDP?
<https://www.project-syndicate.org/commentary/successor-to-gdp-indicator-of-prosperity-by-diane-coyle-2019-02>

Facebook is free, but should it count toward GDP anyway?
<https://www.weforum.org/agenda/2019/05/facebook-is-free-but-should-it-count-toward-gdp-anyway/>

*Making Sense of Unemployment Data
<https://files.stlouisfed.org/files/htdocs/publications/page1-econ/2016-02-01/making-sense-of-unemployment-data.pdf>

CPI Calculator Information
<https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information>

What's in Your Market Basket?
<https://files.stlouisfed.org/files/htdocs/publications/page1-econ/2015-10-01/whats-in-your-market-basket-why-your-inflation-rate-might-differ-from-the-average.pdf>

PCE vs. CPI
https://apps.bea.gov/faq/index.cfm?faq_id=555
<https://www.bea.gov/resources/learning-center/what-to-know-prices-inflation>
<https://www.bea.gov/research/papers/2007/reconciliation-between-consumer-price-index-and-personal-consumption>

Kevin L. Kliesen, "A Guide to Tracking the U.S. Economy," Federal Reserve Bank of St. Louis Review, First Quarter 2014, pp. 35-54. <https://doi.org/10.20955/r.96.35-54>

"Taking the Pulse of the Economy: Measuring GDP," Journal of Economic Perspectives, Spring 2008
https://apps.bea.gov/about/pdf/jep_spring2008.pdf

Lecture 3 National Income Determination

Biwei Chen
(Updated: February 15)

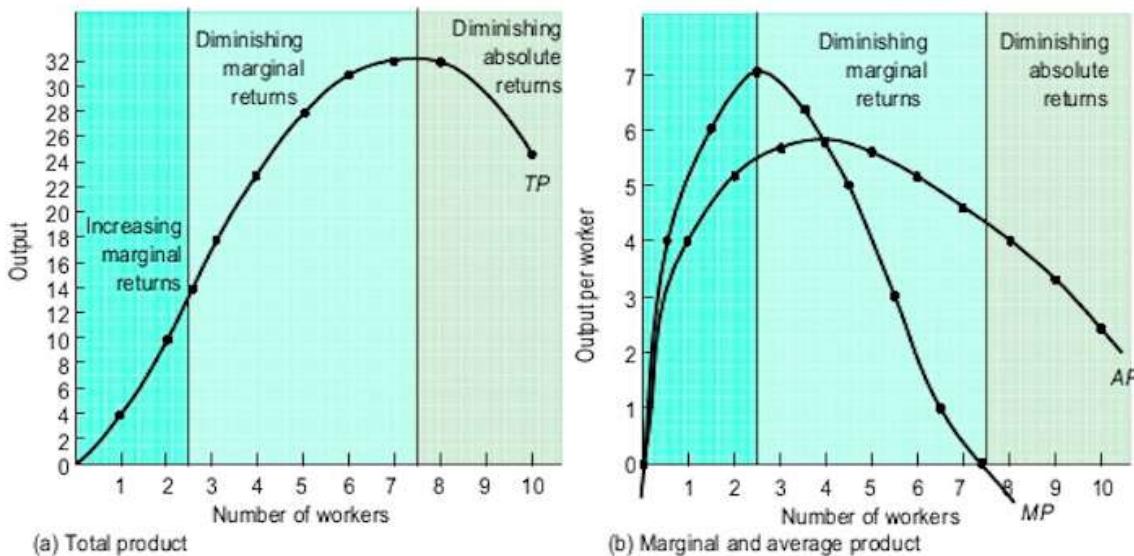
Reference: Mankiw, 2019, Macroeconomics, CH3 National Income & CH11.1 Aggregate Demand
Topics: Production function and technology; income distribution theory; national income determination

I. Production Function

1. Definition: the production function characterizes the relation between the input(s) and output.
2. Math and notation: $Q = f(K, L)$ where K is capital and L is labor. One factor: $Q = f(L)$
3. Marginal products of labor: $MP_L = \Delta Q / \Delta L = Q_L - Q_{L-1} = f(L) - f(L-1)$, for fixed K .
Marginal products of capital: $MP_K = \Delta Q / \Delta K = Q_K - Q_{K-1} = f(K) - f(K-1)$, for fixed L .
4. The law of diminishing MP: 1) K fixed; 2) increasing L ; 3) eventually MP_L will fall.

Key relations among MP (slope along the TP curve), TP, AP (slope of TP from origin).

- 1) $MP > 0$, TP will increase; $MP < 0$, TP will decrease; 2) $MP > AP$, AP will rise; $MP < AP$, AP will fall; 3) $AP = TP/L$, which is the slope of TP from origin; 4) MP is the slope along TP, measuring the rate of change of TP; 5) If MP is a constant, then $MP = AP = \text{constant}$.

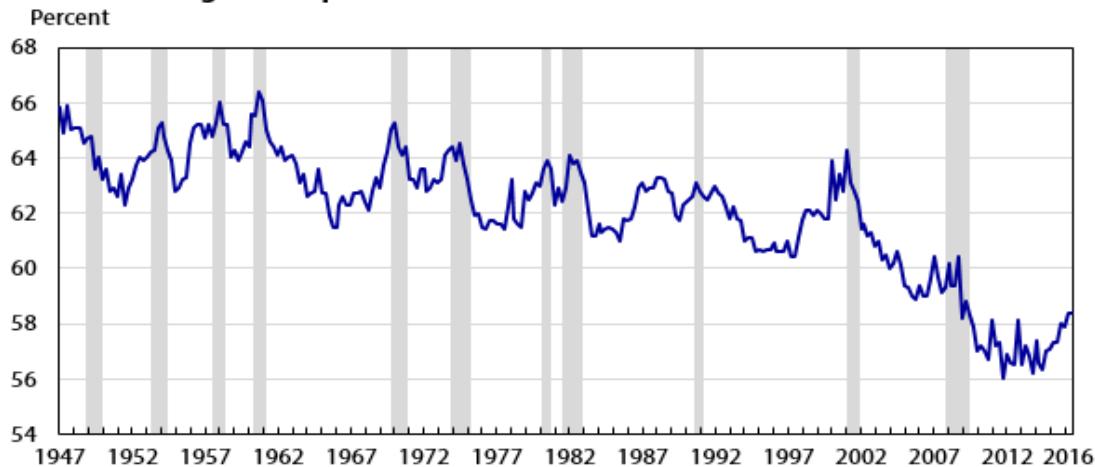


5. Functional forms: linear and nonlinear. Examples: 1) $Q = 2L$; 2) $Q = 2\sqrt{L}$; 3) $Q = L^2$
6. Technology (returns to scale): how output changes as input changes
 - 1) Constant return to scale (CRS): $t * Q = f(tL)$, for $t > 1$, one-to-one response
 - 2) Decreasing return to scale (DRS): $t * Q < f(tL)$, less than one-to-one response
 - 3) Increasing return to scale (IRS): $t * Q > f(tL)$, more than one-to-one response
7. Question: what return to scale is true in the real production process?

II. Neo-classical theory of income distribution

1. The Cobb-Douglas production function: $Q = AK^\alpha L^\beta$, where $\alpha + \beta = 1$ and A is a technology coefficient. What kind of return to scale is the C-D production function?
2. The MP_L and MP_K (Partial derivative's rule): $MP_L = \alpha Q/L$ and $MP_K = \beta Q/K$. Each factor's MP is proportional to its average product. Alpha is the capital share, beta the labor share.
3. Euler's theorem of income distribution: $Q = MP_K K + MP_L L = \alpha Q + \beta Q$, which states that real output is distributed proportionally to capital and labor according to their shares of contribution.
4. National income=capital income + labor income. Empirical pattern: see figure below.

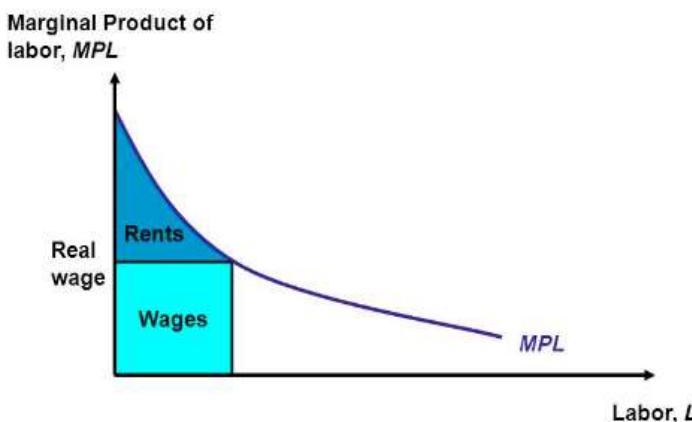
Figure 1. Labor's share of output in the nonfarm business sector, first quarter 1947 through third quarter 2016



Note: Shaded areas indicate recessions, as determined by the National Bureau of Economic Research.

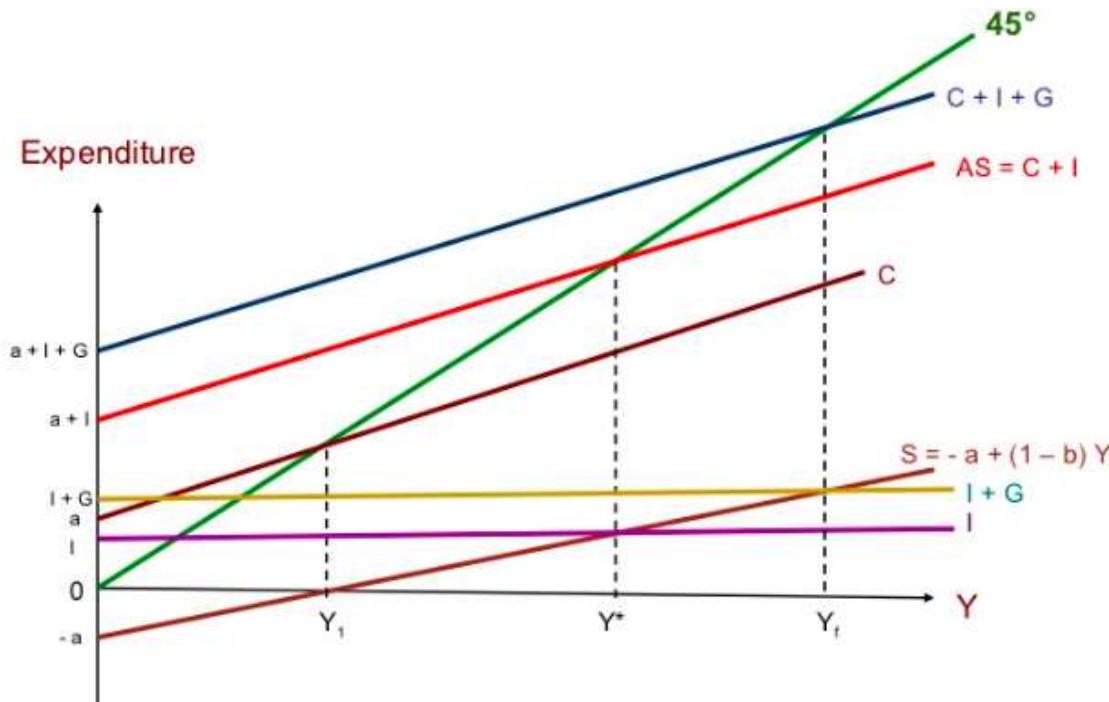
Source: U.S. Bureau of Labor Statistics.

5. Real wage and real rent: in competitive market equilibrium, firms hire workers and rent capitals by the principle of marginal cost equals marginal revenue $MC=MR$. 1) $W=P^*MPL$; 2) $R=P^*MPK$. Therefore, real wage $w=W/P=MPL$ and real interest $r=R/P=MPK$, which states that worker's real wage is determined by marginal product of labor and real interest is determined by MPK.
6. Demand for labor: $W=P^*MPL$; Demand for capital: $R=P^*MPK$.
7. Enhancement: $Q = rK + wL = MP_K K + MP_L L = \alpha Q + \beta Q$



III. Keynes' theory of national income determination (aggregate supply and aggregate demand)

1. In equilibrium, National income = Expenditure. $Y=C+I+G$. ($AS=AD$)
2. Consumption function: $C=C_0+MPC*(Y-T)$, C_0 -autonomous consumption; MPC-marginal propensity to consumer, which shall be less than 1; T is tax and $(Y-T)$ is disposable income.
3. Investment function: $I=I(r)$, investment depends negatively on real interest rate.
4. Government revenue T and expenditure G : Exogenous.
5. Keynes' cross: $E=Y$. Along the 45-degree line the economy is in $AD=AS$ equilibrium. Aggregate demand is a function of aggregate output. By equation $E=C(Y-T)+I(r)+G=Y$, solve for Y^*



Note: $C=a+bY=C_0+MPC*Y$, $S=Y-C$, I and G are constants.

6. Multiplier effects: how aggregate income change as a result of initial change in C , I , G , T .

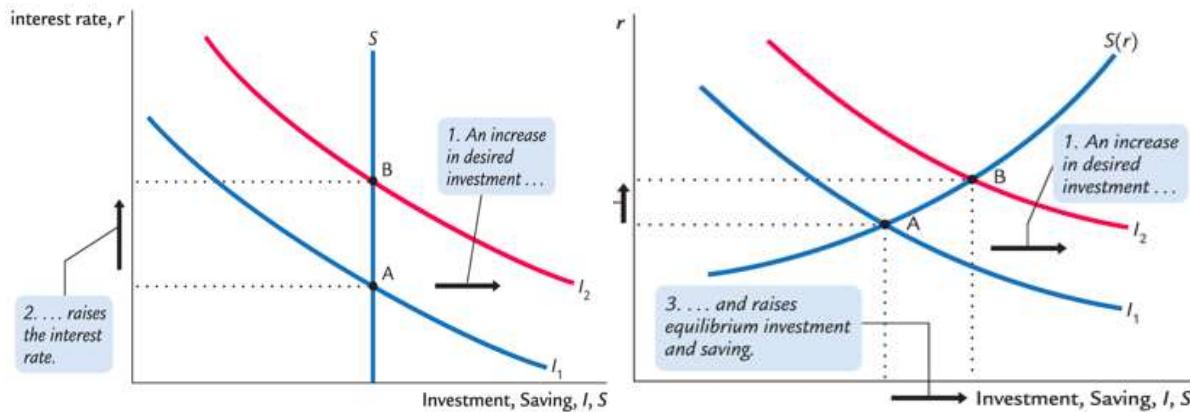
- 1) investment multiplier $m_I=1/(1-MPC)$
- 2) government multiplier $m_G=1/(1-MPC)$
- 3) Tax multiplier $m_T=-MPC/(1-MPC)$

How to derive the multipliers? Illustrate with investment multiplier.

$Y=C_0+MPC(Y-T)+I+G$, collecting terms for Y we have $Y-MPC*Y=(1-MPC)Y=C_0-MPC*T+I+G$, therefore, $Y=(C_0-MPC*T+I+G)/(1-MPC)$. The coefficient of I is the investment multiplier.

IV. Product market and financial market equilibria

1. Income=Expenditure or $Y=E$. Price-quantity equilibrium. Graph.
 $Y=C(Y)+I(r)+G$, real interest rate adjusts demand and supply of products to equilibrium.
2. Saving=Investment ($Y-C-G=S=I$) or $S=I$. Interest-credit equilibrium. Graph.
 $S=(Y-C-T) + (T-G) = I(r)$, where $Y-C-T$ is private saving and $T-G$ is public saving.



3. Government policy effects in Keynesian model

- 1) What would be the effects of a tax cut on national output and market interest rate, all else equal? Ans: Cutting tax will increase disposable income and private sector consumption. National saving is $S=Y-C-G$, substituting $C=C_0+MPC(Y-T)$ into S , we have $Y-C_0-MPC*Y+MPC*T-G$. As T falls, national saving will fall, then r will go up, and equilibrium investment will go down. (tax cut reduces saving, increases r , and crowds out I partially)
- 2) What would be the effect of increasing G on national output and market interest rate, all else constant? Ans: When G increases, S will go down, r will go up, and equilibrium I will go down. (G crowding out I , fully)

Readings

Estimating the U.S. labor share

<https://www.bls.gov/opub/mlr/2017/article/estimating-the-us-labor-share.htm>

How Income Inequality Is Affected by Labor Share

<https://www.stlouisfed.org/on-the-economy/2017/july/income-inequality-affected-labor-share>

Capitalism is failing. People want a job with a decent wage – why is that so hard?

<https://www.brookings.edu/opinions/capitalism-is-failing-people-want-a-job-with-a-decent-wage-why-is-that-so-hard/>

Nakamura, Emi, and Jón Steinsson. 2014. "Fiscal Stimulus in a Monetary Union: Evidence from US Regions." *American Economic Review*, 104 (3): 753-92.

Lecture 4 Consumption Function Theory

Biwei Chen
 (Updated: February 15)

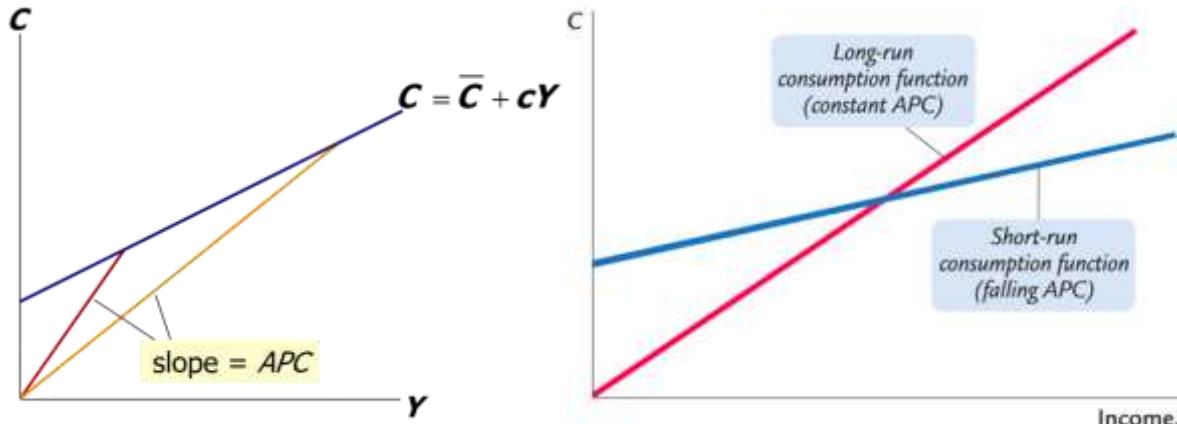
Reference: Mankiw, CH19.1 The Micro-foundation of Consumption and Investment

I. Irving Fisher (1930): The Theory of Interest

1. Income is the alpha and omega of economic life.
2. Income deducting consumption is saving. $Y=C+S$
3. Saving is investment for future consumption. $Y=C+S=C+I$
4. Investment is the balancing of consumption over time.
5. Capital generates income. Income is derived from capital goods.
6. The value of the capital is derived from the value of income.
7. Interest is the cost of borrowing and return to lending.
8. Interest is determined by 1) impatience to consume; and 2) opportunity to invest.
9. The rate of interest links all future incomes and the value of capital. $PV_0 = \sum_{t=1}^T Y_t / (1 + i)^t$,

II. Keynesian consumption function

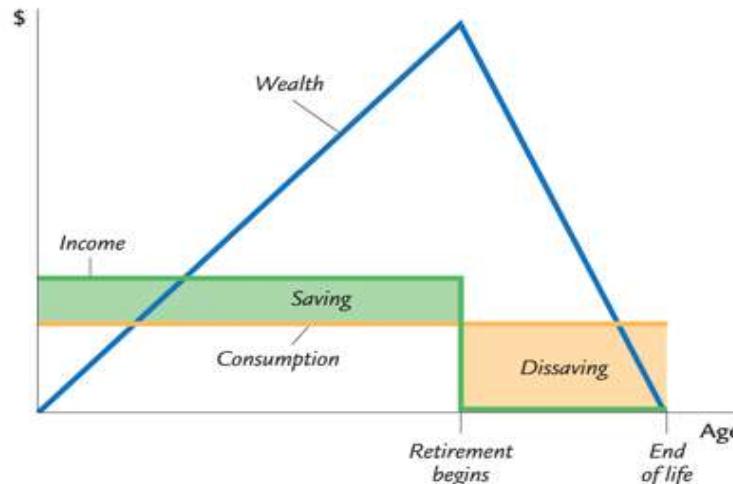
1. Consumption is determined by income and marginal propensity to consume.
2. Keynesian consumption function is a short-term concept: $C = C_0 + MPC * Y$
3. Implications: 1) strong correlation between income and consumption; 2) since $MPC > 0$, high income households tend to consume more; 3) since $MPC < 1$, high income households tend to save more ($S=Y-C$); 4) average consumption APC will fall as income rises ($C/Y = C_0/Y + MPC$); 5) average saving will rise as income rises ($S/Y = 1 - MPC - C_0/Y$).



4. Empirical evidence: 1) early work using household surveys seemed to support implications 2 and 3 above; 2) the rise in income after WWII was not accompanied by higher average saving and the average propensity to consume did not fall as income rose (Simon Kuznets discovered that the APC was stable over long periods); 3) the evidence seemed to suggest long-run consumption function was steeper than the short-run consumption function.

III. Franco Modigliani (1950s): Life-cycle Hypothesis

1. Idea: Income varies systematically over the phases of consumer's life cycle, and saving allows the consumer to smooth consumption over time.
2. Model: $C = aW + bY = W/T + RY/T$, where W is the initial wealth, Y is the expected annual income until retirement, R is the number of years until retirement, T is the lifetime in years.
Assumptions: zero interest rate and optimal consumption smoothing.
3. Implications: 1) consumption depends on both wealth and income; 2) expected income matters more than current income.



IV. Milton Friedman (1957): Permanent Income Hypothesis

1. Current income = permanent income + transitory income ($Y = Y_P + Y_T$), the transitory income is unpredictable or random, and the permanent income is an expected value of all future incomes.
2. Permanent income is a long-term average of all expected future incomes, depending crucially on market interest rates. Annuity formula: $Y_P = i * W = i * PV_0 = i * \sum_{t=1}^T Y_t / (1 + i)^t$
3. By decomposing it into two parts, current consumption = permanent consumption + transitory consumption, $C = C_P + C_T = kY_P + C_T$, where $C_T \sim N(0, \sigma^2)$
4. Transitory income and transitory consumption are both stochastic and unpredictable (random walk). Expected value of transitory variable is zero. Current consumption is determined by permanent income instead of current income.

Reference

Irving Fisher, 1930, CH1, The Theory of Interest. <http://www.econlib.org/library/YPDBooks/Fisher/fshToI.html>

Milton Friedman, 1957, A Theory of Consumption Function. <https://www.nber.org/books/frie57-1>

The Price of Capital Goods and the Threat to Investment

<https://blogs.imf.org/2019/07/01/the-price-of-capital-goods-and-the-threat-to-investment/>

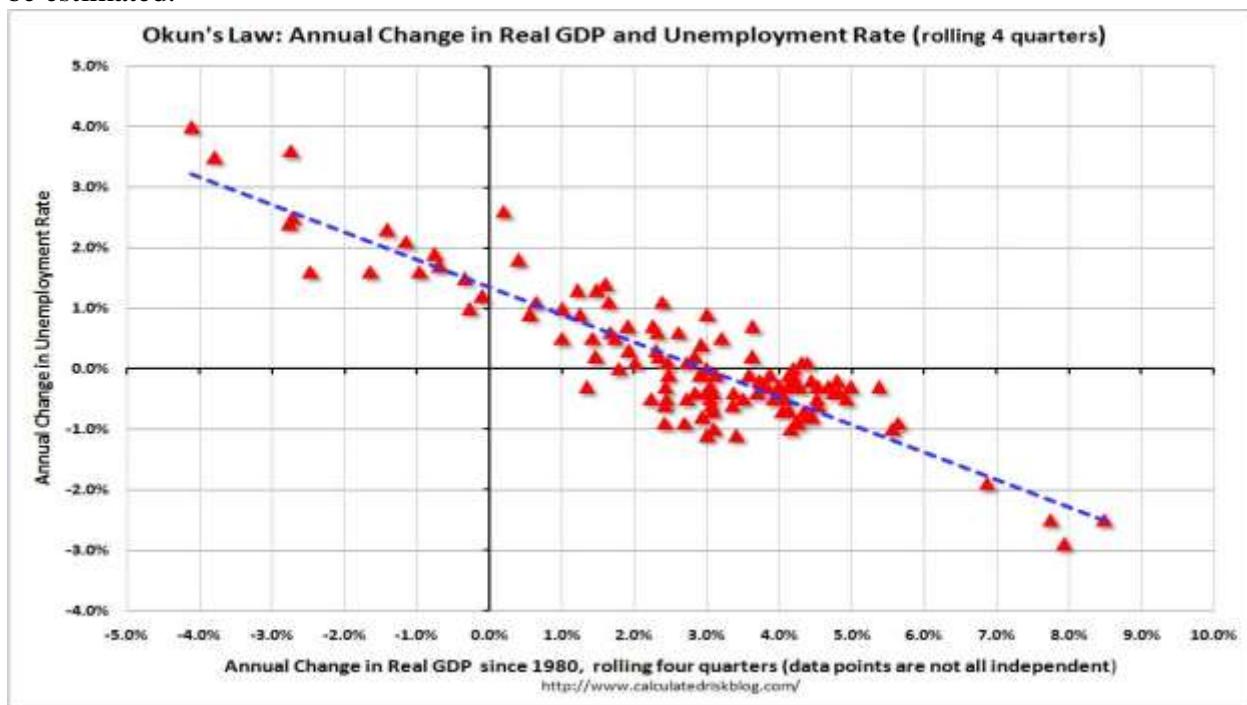
Lecture 5 Unemployment and the Labor Market

Biwei Chen
 (Updated: February 27)

Reference: Mankiw, 2019, CH7 Unemployment and the Labor Market

I. Output and Employment

1. Output and employment are positively related since labor is the key input of production. Therefore, real GDP growth rate and unemployment are negatively related, though with time lags.
2. An empirical observation by Arthur M. Okun (1962) later became known as “Okun’s law,” which states that for every 1% increase in the unemployment rate, a country’s GDP will be roughly an additional 2% lower than its potential GDP.
3. The gap version of Okun’s law may be written as $(Y-Y^*)/Y^*=a(UR-UR^*)$, where Y^* is the potential output and UR^* is the natural rate of unemployment, both are unobservable and can only be estimated.



II. Key indicators and patterns

- 1) Unemployment Rate = unemployed/labor force
- 2) Employment Rate = employed/labor force = 1 - UR
- 3) Labor Force Participation Rate = labor force/working-age population
- 4) Employment to Population Ratio = employed/working-age population
- 5) Cyclical pattern: unemployment fluctuates with the business cycle; it rises quickly but falls slowly.

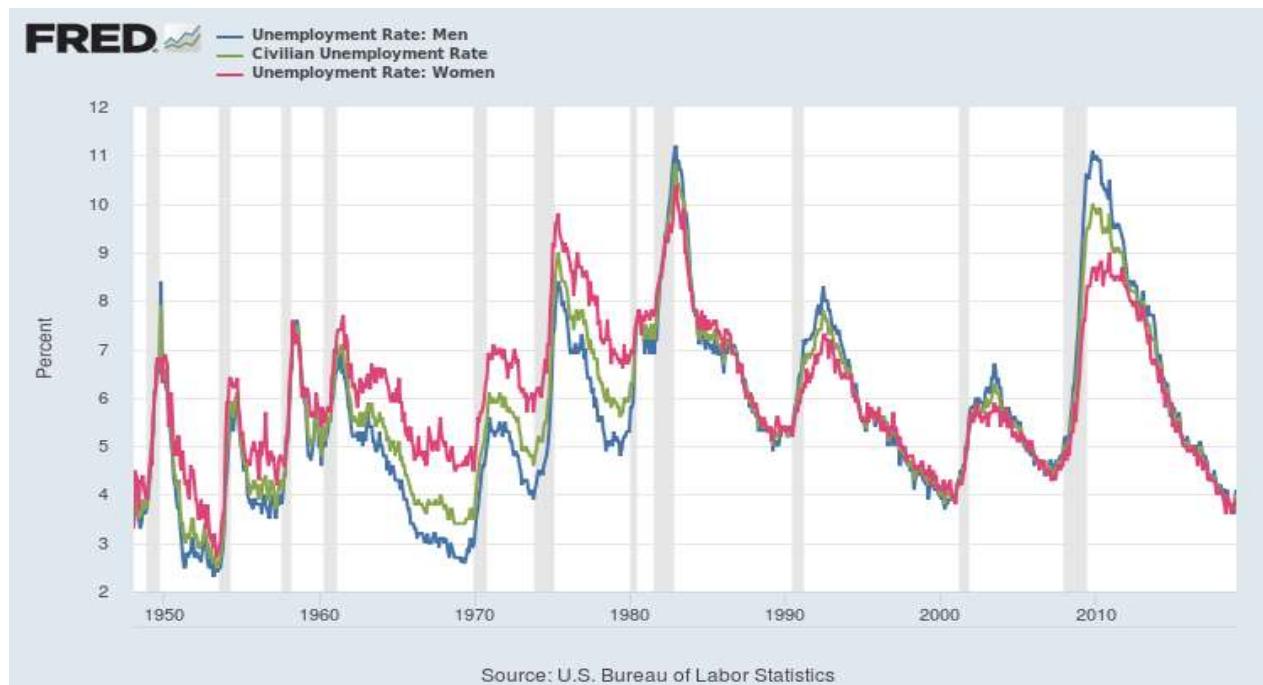


Figure 1: U.S. unemployment rate by gender from January 1948 to January 2019.

<https://voxeu.org/article/gender-unemployment-gap>

<https://www.stlouisfed.org/publications/regional-economist/second-quarter-2018/gender-risk-unemployment>

- 6) Unemployment spell: it rises sharply in recent decades. The median duration of unemployment measures one facet of the severity of unemployment. The median is the point that splits the distribution of unemployment duration in half. What causes rising unemployment spell?

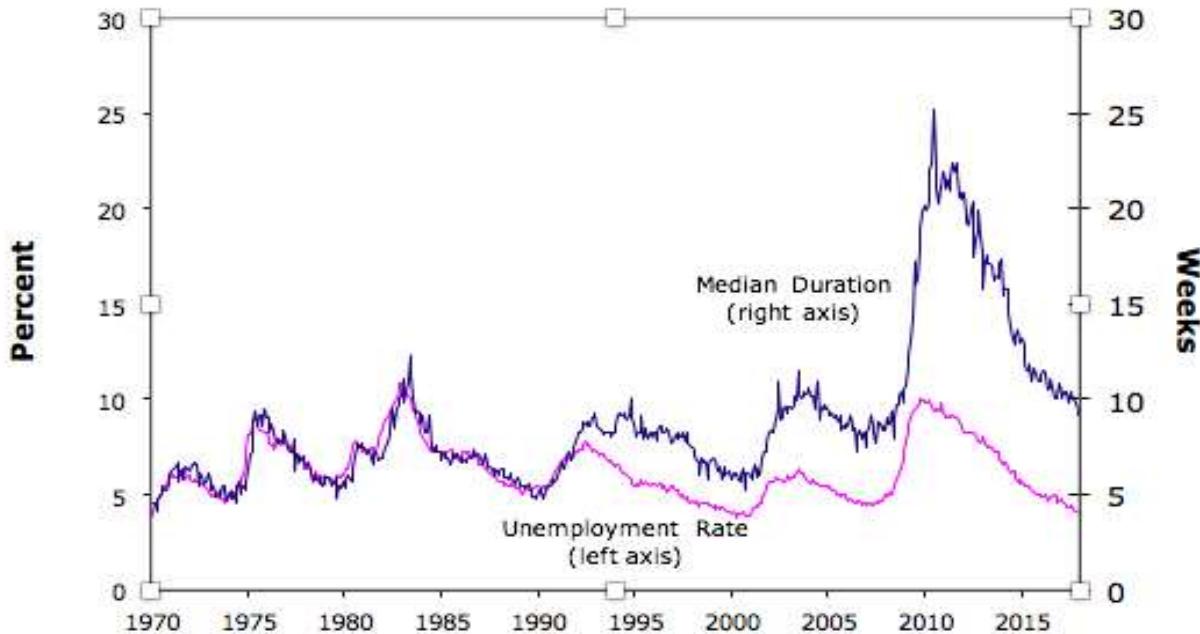


Figure 2: U.S. unemployment rate and duration from 1970 to 2017

III. A model for the natural rate of unemployment

1. Job separation rate (s): the fraction of employed individuals who lose or leave their jobs each month. Job finding rate (f): the fraction of unemployed individuals who find a job each month
2. Labor market long run equilibrium (steady state): $sE = fU$
3. Natural rate of unemployment: the average rate of unemployment around which the economy fluctuates. Derive $UR^* = (U/L)^* = s/(s+f)$. Example: suppose 1% of employed workers lose their job and 19% of unemployed workers find jobs, what would be the natural rate of unemployment?
4. What is u^* or NAIRU? <https://www.brookings.edu/blog/up-front/2019/03/06/what-is-u/>



IV. Causes of Unemployment

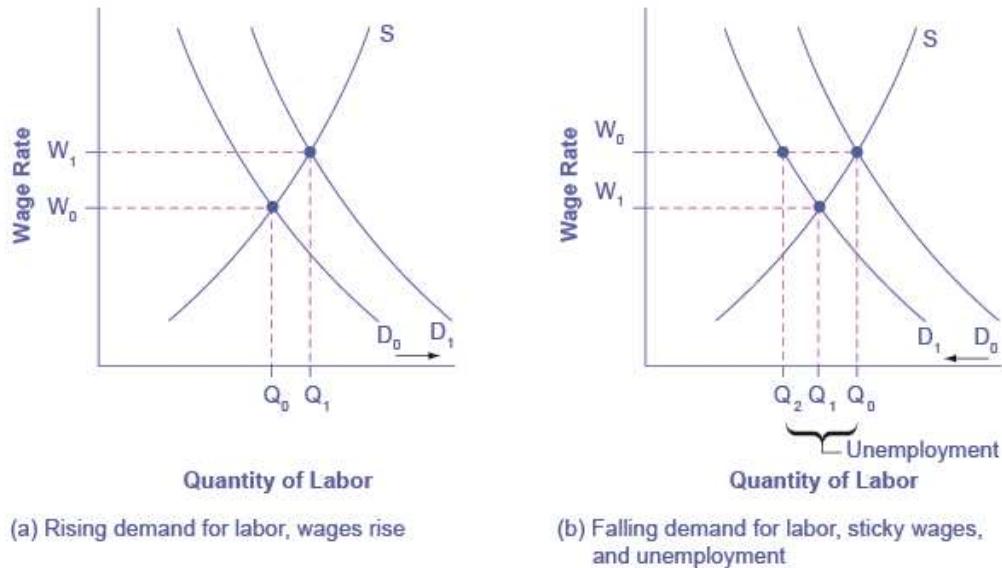
There are a good number of causes of unemployment. Economists want to filter out “noises” and focus on the long-term trend of unemployment. Natural rate of unemployment is a combination of frictional and structural unemployment that persists in an efficient, expanding economy when labor and resource markets are in equilibrium.

1. Frictional unemployment: it takes time for workers to find new jobs due to searching, matching, and transition costs. It occurs even when wages are flexible and there are enough jobs in the economy. Empirical evidence shows that two causes are welfare payments and unemployment insurance.

2. Structural unemployment: wage rigidity (D-S model)

The structural unemployment is persistent over the business cycle. It rises quickly but falls slowly. Why? According to the D-S model, labor market clears when wage balances quantity demanded for labor and quantity supplied of labor. Aside from frictional unemployment, there should not be any persistent pattern of unemployment if wages are flexible. Therefore, the explanation of structural unemployment centers on artificially higher wage than equilibrium wage, blocking the smooth functioning of the labor market.

In graph (a) below, when demand for workers rises in economic expansion, wage will rise. This is what we observe in the labor market. In graph (b) below, when demand for workers declines during the recessions, since wages are sticky, there will be more quantity demanded than supplied, causing a rapid rise in unemployment. Then, what causes the slow decline in unemployment during the expansion? Is it because demand for workers rise very slowly?



Structural unemployment is caused by wage rigidity. What are the institutional factors and what are the policy implications? The common factors include:

- 1) Minimum-wage laws and regulations (harm the marginal workers most)
- 2) Labor union's bargaining power (demand for more benefits, including higher wage)
- 3) Efficiency wage (reduce turnover, elicit worker effort, prevent worker collective action, and attract higher quality employees)
- 4) Price and wage adjustment cost due to binding contractual arrangements

3. Sectoral shifts: changes in the composition of demand for labor among industries or regions

- 1) Technological change (As late as 1976, Kodak commanded 90% of film sales and 85% of camera sales in the US. On September 3, 2013, Kodak announced that it emerged from bankruptcy as a technology company focused on imaging for business.);
- 2) International trade and competition (Due to increasing imports of cheaper foreign-made textiles, particularly since the expiration in 2005 of long-standing quotas on textiles from China, the U.S. textile industry has been in decline for years. Tens of thousands of workers in this industry have lost jobs).
- 3) Sectoral shifts are distinct from recessions (which also cause unemployment). In recessions, there is a general fall in demand across industries, and the unemployment that results is cyclical. Sectoral shifts, though, are changes in the composition of demand across industries and lead to frictional unemployment, as described above.

III. Policy implications

1. Repeal the minimum-wage law
2. Regulate the unions and their bargain power
3. Reduce the generosity of unemployment insurance
4. Provide public goods (information) for job market participants
5. Provide public training program for disadvantaged workers
6. Lower the real-wage by inflating the price level unexpectedly (*!*)

Readings

Real GDP Growth and the Unemployment Rate

<https://www.calculatedriskblog.com/2010/10/real-gdp-growth-and-unemployment-rate.html>

Unemployment – The Economic Lowdown Video Series Episode 10

<https://www.stlouisfed.org/education/economic-lowdown-video-series/episode-10-unemployment>

How useful is Okun's law?

<https://www.kansascityfed.org/publicat/econrev/pdf/4q07knotek.pdf>

Okun's Law: A Meaningful Guide for Monetary Policy?

https://files.stlouisfed.org/files/htdocs/publications/es/12/ES_2012-06-08.pdf

Unemployment by Lawrence H. Summers

<https://www.econlib.org/library/Enc/Unemployment.html>

How to Reduce Unemployment, If We Want

<https://www.econlib.org/library/Columns/Teachers/unemployment.html>

20190409 Meet the millions of young adults who are out of work

<https://www.brookings.edu/research/young-adults-who-are-out-of-work/>

Patterns of unemployment in the U.S.

<https://opentextbc.ca/principlesofeconomics/chapter/21-2-patterns-of-unemployment/>

What causes changes in unemployment over the short run?

<https://opentextbc.ca/principlesofeconomics/chapter/21-3-what-causes-changes-in-unemployment-over-the-short-run/>

What causes changes in unemployment over the long run?

<https://opentextbc.ca/principlesofeconomics/chapter/21-4-what-causes-changes-in-unemployment-over-the-long-run/>

201602 Making Sense of Unemployment Data (Page One Economics)

<https://files.stlouisfed.org/files/htdocs/publications/page1-econ/2016-02-01/making-sense-of-unemployment-data.pdf>

Efficiency Wage Theories: A Partial Evaluation <https://www.nber.org/papers/w1906>

Current Population Survey

<https://www.bls.gov/data/>

<https://fred.stlouisfed.org/categories/12>

<https://research.stlouisfed.org/publications/employment-research/>

Chart of the Week: An Answer to the U.S. Wage Puzzle

<https://blogs.imf.org/2018/07/10/chart-of-the-week-an-answer-to-the-u-s-wage-puzzle/>

Understanding U.S. Wage Dynamics

<https://www.imf.org/en/Publications/WP/Issues/2018/06/15/Understanding-U-S-45992>

Hornstein-Kudlyak-Lange Non-Employment Index

https://www.richmondfed.org/research/national_economy/non_employment_index

20190702 All school and no work becoming the norm for American teens

www.brookings.edu/blog/up-front/2019/07/02/all-school-and-no-work-becoming-the-norm-for-american-teens

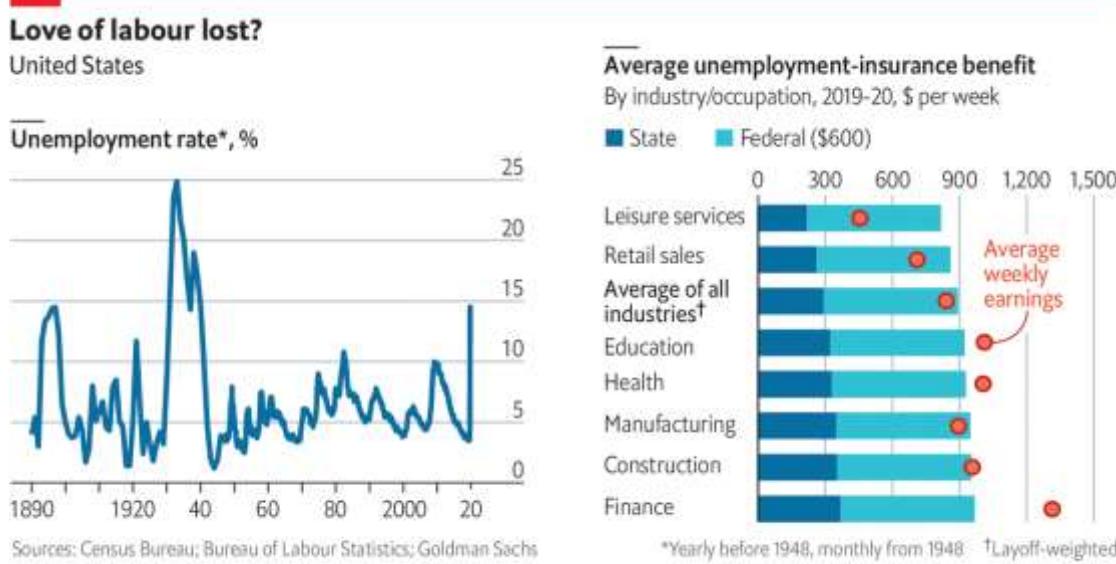
A unified approach to measuring u*

<https://www.brookings.edu/bpea-articles/a-unified-approach-to-measuring-u/>

20200406 America's Historic Unemployment Cliff: 10 Facts You Should Know

<https://fee.org/articles/america-s-historic-unemployment-cliff-10-facts-you-should-know/>

A plague on jobs <https://www.economist.com/graphic-detail/2020/05/15/a-plague-on-jobs>



Lecture 6 Inflation: Causes and Effects

Biwei Chen (Updated: March 5)

Reference: Mankiw, 2019, CH5 Inflation: Its Causes, Effects, and Social Costs

1. Inflation: Concepts and Data

- 1) Definition: a general rise in the overall price level.
- 2) Measurements: CPI, PCE, GDP deflator
- 3) U.S. inflation: historical data since 1913

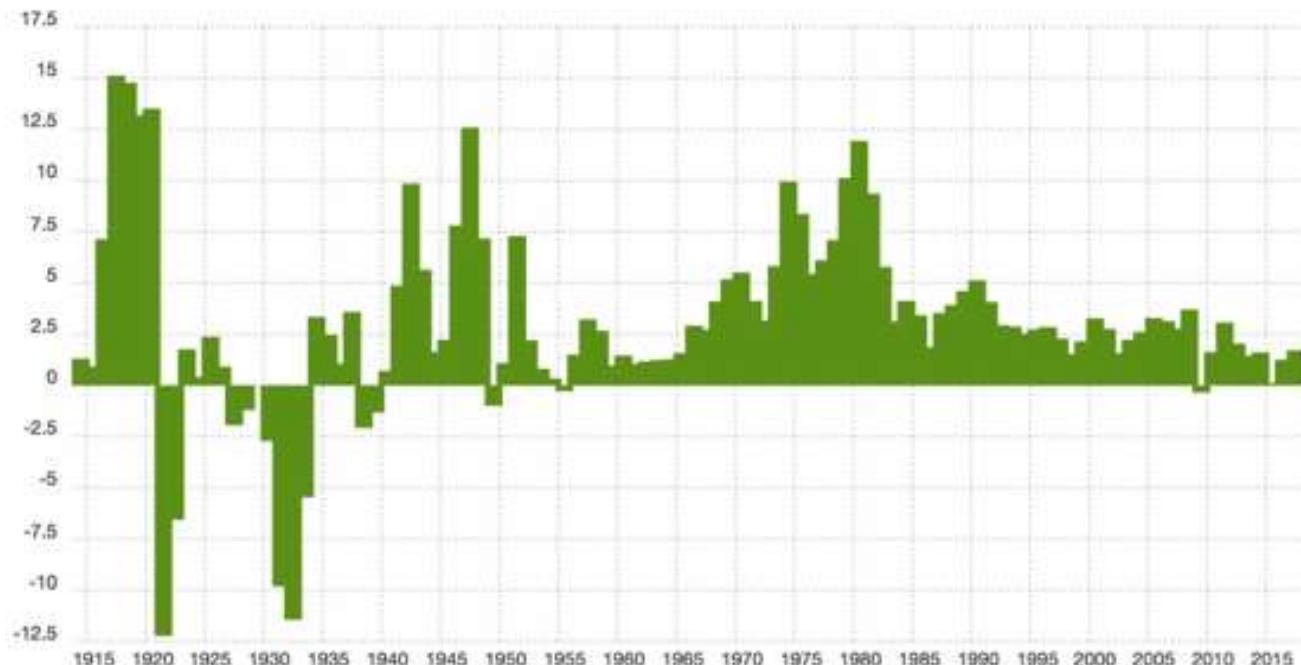
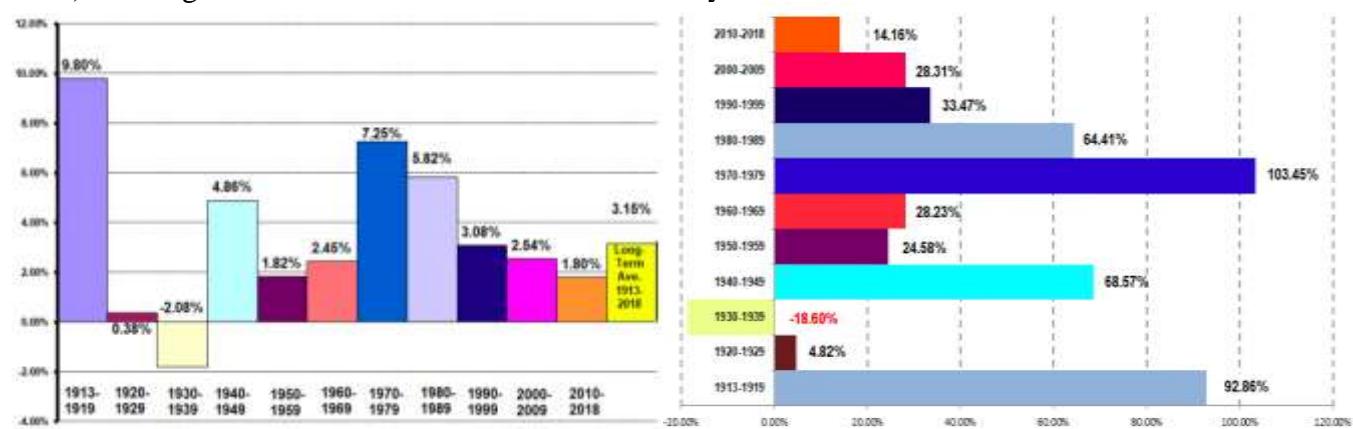


Figure 1: U.S. inflation rate (CPI all item) since 1913; Source: U.S. Bureau of Labor Statistics

4) Average and cumulative annual inflation rate by decade



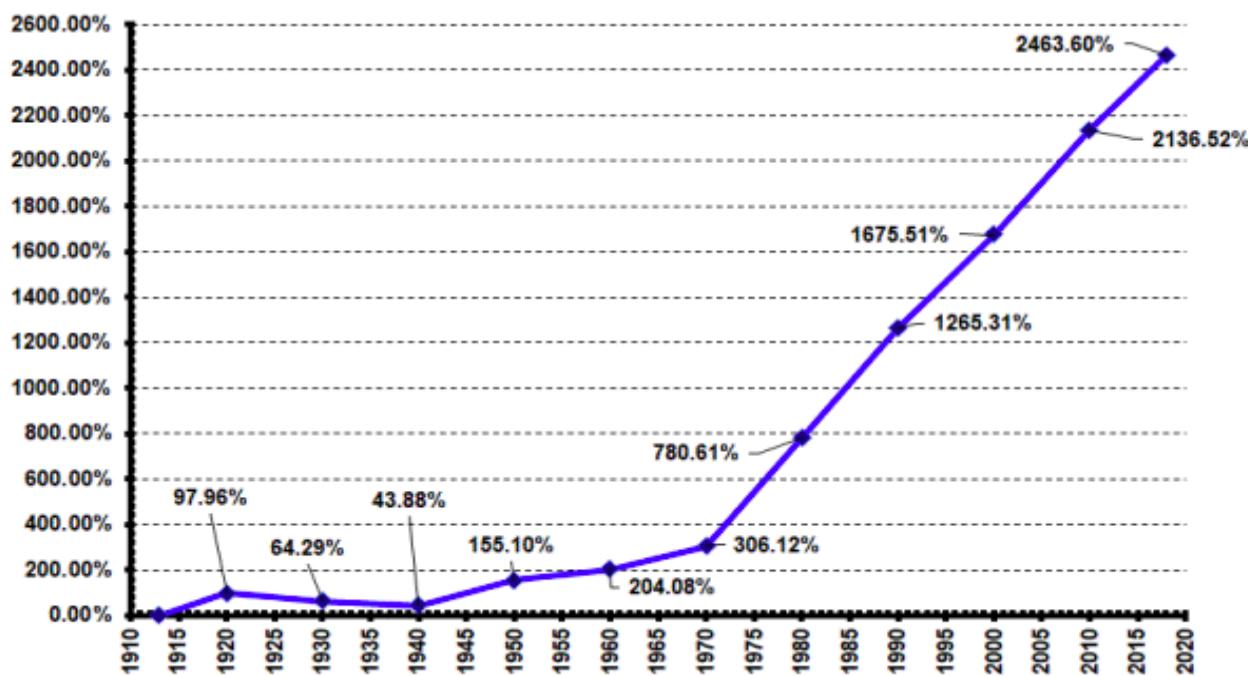


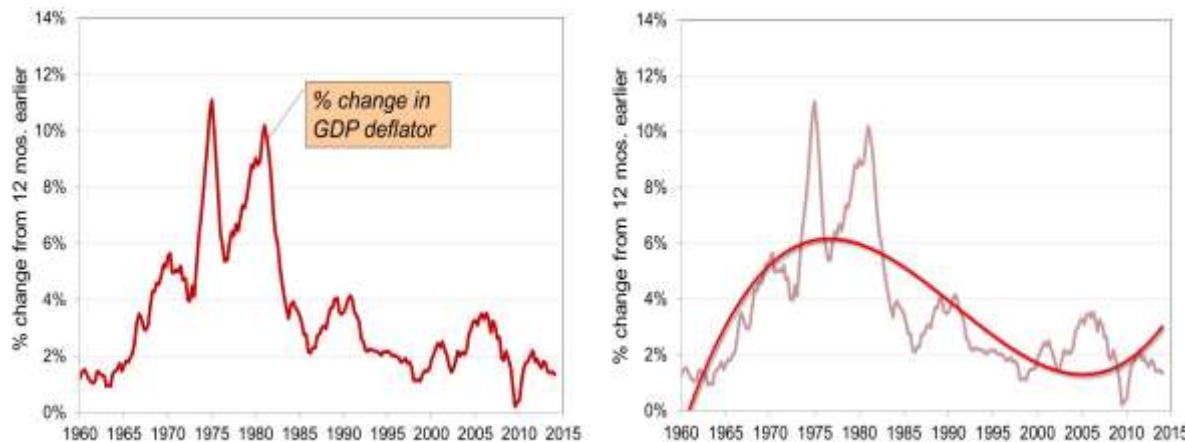
Figure: U.S. cumulative inflation rate 1913-2018 (compounded annual growth rate - geometric mean)

II. Inflation Causes

Inflation is always and everywhere a monetary phenomenon in the sense that it is and can be produced only by a more rapid increase in the quantity of money than in output. ... A steady rate of monetary growth at a moderate level can provide a framework under which a country can have little inflation and much growth. It will not produce perfect stability; it will not produce heaven on earth; but it can make an important contribution to a stable economic society.

—Milton Friedman (1970) The Counter-Revolution in Monetary Theory

1. What are the key driving forces of inflation? To filter out the short run fluctuations and noises, economists focus on the long run trend of the inflation. See graphs below for the long run trend of the U.S. inflation rate from 1960 to 2014. High inflation in the late 1970s and early 1980s.



2. Quantity theory: $MV=PQ$ (monetarist view on inflation)

- 1) Inflation is the rise in P and inflation rate is the percentage growth in the price level;
- 2) M causes P , positive relation, all else equal;
- 3) V causes P , positive relation, all else equal;
- 4) Q causes P , negative relation, all else equal;
- 5) In difference/differential equations, we can derive $\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Q}{Q}$; Assuming V is a constant, then inflation rate is the difference between M and Q growth rates. In other words, Inflation rate=money growth rate-output growth rate. Too much money chasing too few goods.
- 6) Examples: what would be inflation rate if a. M grows by 10%; b. Q grows 5%; c. Both.
- 7) Empirical evidence: U.S. inflation and money growth, 1960–2014.

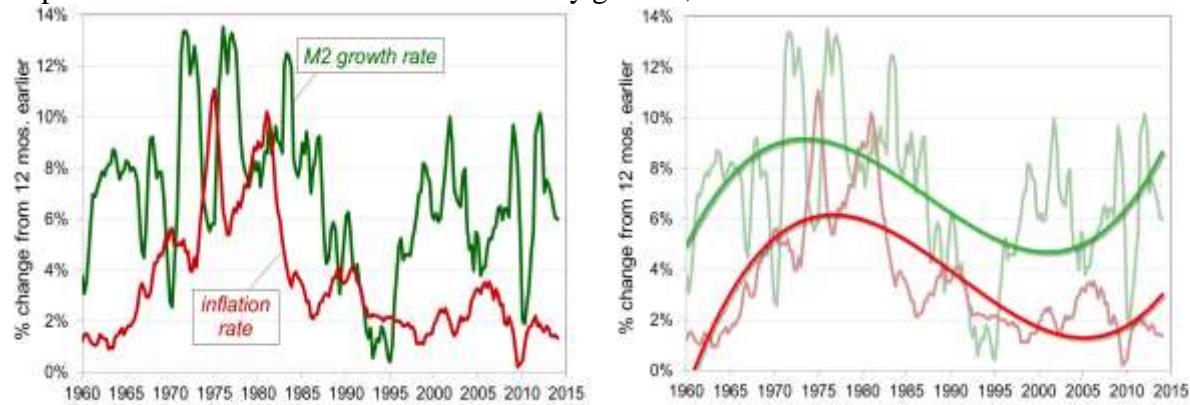
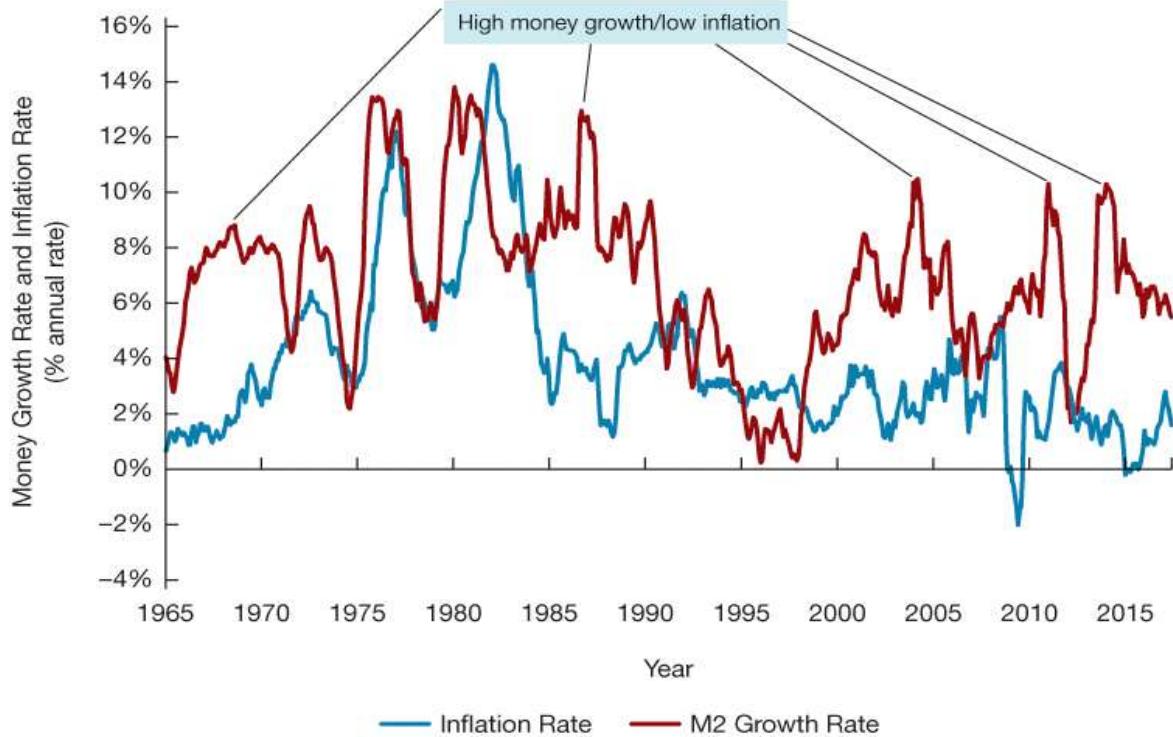


Figure below: Annual U.S. Inflation and M2 Growth Rates, 1965 – 2015



8) Empirical evidence: US and International data on inflation and money growth.

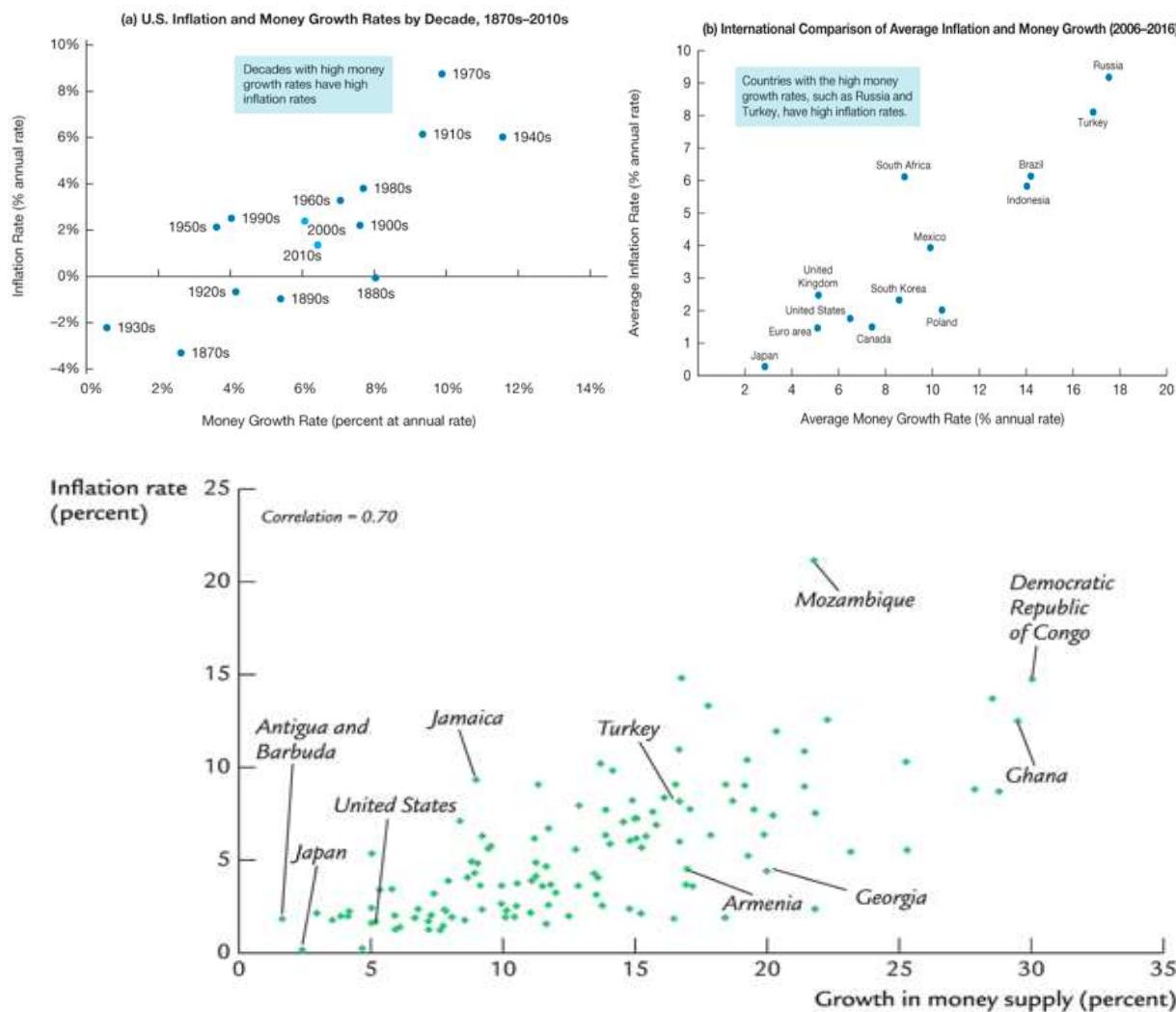


Figure: International data on inflation and money growth 2000-2013; Source: IMF

3. AD-AS theory: AD, AS or both.
 - 1) Draw a graph for a rise in AD (due to rises in M or V). Example: most the economic booms.
 - 2) Draw a graph for a decline in AS (due to falls in Q). Example: U.S. stagflation in 1970s.
 - 3) Examples: loose monetary policy and credit conditions, financial market boom, OPEC production cutback and oil shock. Demand shock vs. Supply shock in driving the inflation.
4. Keynesians: interest rates, demand, and the slack or tightness of resource markets. In the Fed's view, slack and tightness cause inflation and deflation. (Lack of support).
5. Counter-argument from Scott Sumner: "Yes, the unemployment rate fell to barely over 1% during WWII, and we were certainly operating at capacity. But we also had double-digit inflation during 1980 and 1981, a time of 7% to 8% unemployment. In other countries, you can find even more extreme examples of stagflation. Excessive spending can occur when the economy is far from capacity." <https://www.econlib.org/excessive-debt-doesnt-cause-inflation/>

6. Can expectation augmented Phillips curve (inflation-unemployment tradeoff) save the trouble?
7. John Cochrane: “Since expectations are hard to measure independently, this view is hard to disprove, but that also means it is hard to use for anything more than storytelling after the fact.”
8. New Keynesians: Fed’s announcement of its inflation target should be enough to “coordinate expectations,” and force the economy to jump to one of many possible “multiple equilibria.” (#%?)
9. Seigniorage and hyperinflation
 - 1) Seigniorage: the “revenue” raised from printing money. Printing money is a privilege of the government. If printing too much money causes inflation, then inflation is like imposing tax.
 - 2) Hyperinflation: above 50% inflation rate per month. Watch a video on Zimbabwe’s hyperinflation <https://www.youtube.com/watch?v=78-BIZXm7wA> What caused runaway inflation? What would happen to the economy with hyperinflation?

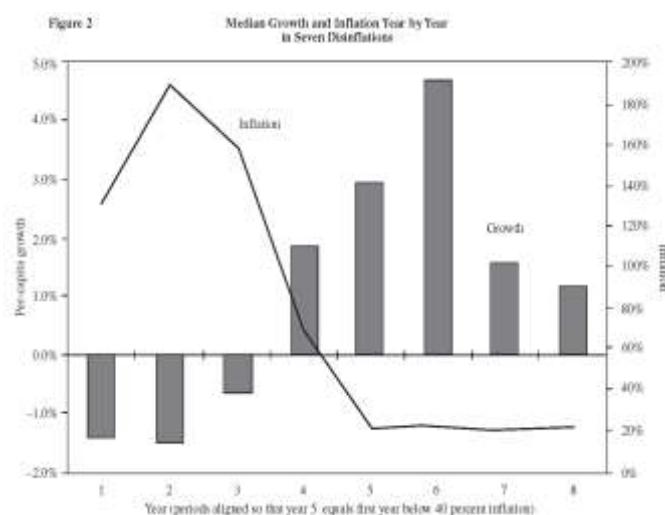
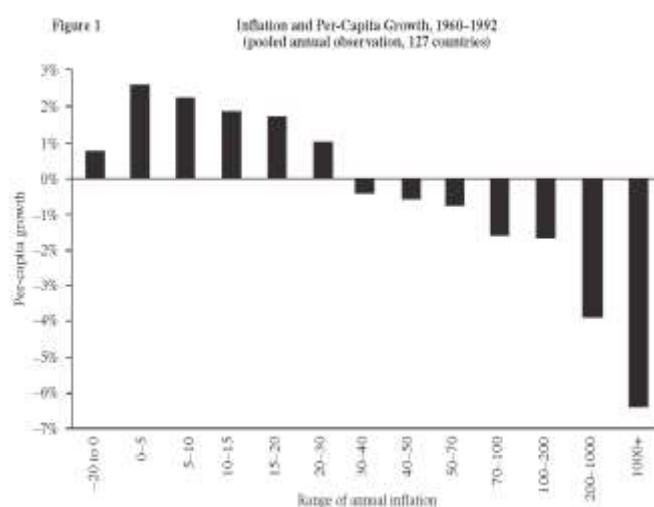
Country	Period	CPI Inflation % per year	M2 growth % per year
Israel	1983-85	338%	305%
Brazil	1987-94	1,256	1,451
Bolivia	1983-86	1,818	1,727
Ukraine	1992-94	2,089	1,029
Argentina	1988-90	2,671	1,583
Dem. Republic of Congo/Zaire	1990-96	3,039	2,373
Angola	1995-96	4,145	4,106
Peru	1988-90	5,050	3,517
Zimbabwe	2005-07	5,316	9,914



<http://www.rtaland.com/news/hyperinflation-21-countries-in-25-years>

III. Inflation: Macroeconomic Effects

1. Inflation and output growth: Negative relation. Barro (1996), Bruno and Easterly (1996)



2. Inflation and interest rates

- 1) What is the relation between the aggregate price level and interest rates in the economy?
- 2) Fisher effect: nominal interest rate equals real interest rate plus expected future inflation rate.
- 3) Fisher equation: $i \approx r + \pi^e$, where π^e denotes expected inflation rate.
- 4) Derivation: $(1 + r)(1 + \pi^e) = 1 + i$, no-arbitrage condition in the financial markets.
- 5) Market interest rates are forward-looking (ex ante), so as financial asset prices.
- 6) Market interest rates data <https://www.federalreserve.gov/releases/h15/>
- 7) The nominal interest rate in Fisher equation refers to riskless rate. In financial markets, interest rates are different because of risk premium, liquidity premium, and term premium.
- 8) Application: after the 2008 financial crisis, the Fed cut the interest rate to almost zero. What is the value of the real interest rate? You can impute or you can refer to the Treasury inflation protected securities (TIPS). <https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/Historic-LongTerm-Rate-Data-Visualization.aspx>
- 9) Example: suppose V is constant, M is growing 5% per year, Y is growing 2% per year, and $r = 4$. Solve for i . If the Fed increases the money growth rate by 2 % per year, find Δi .

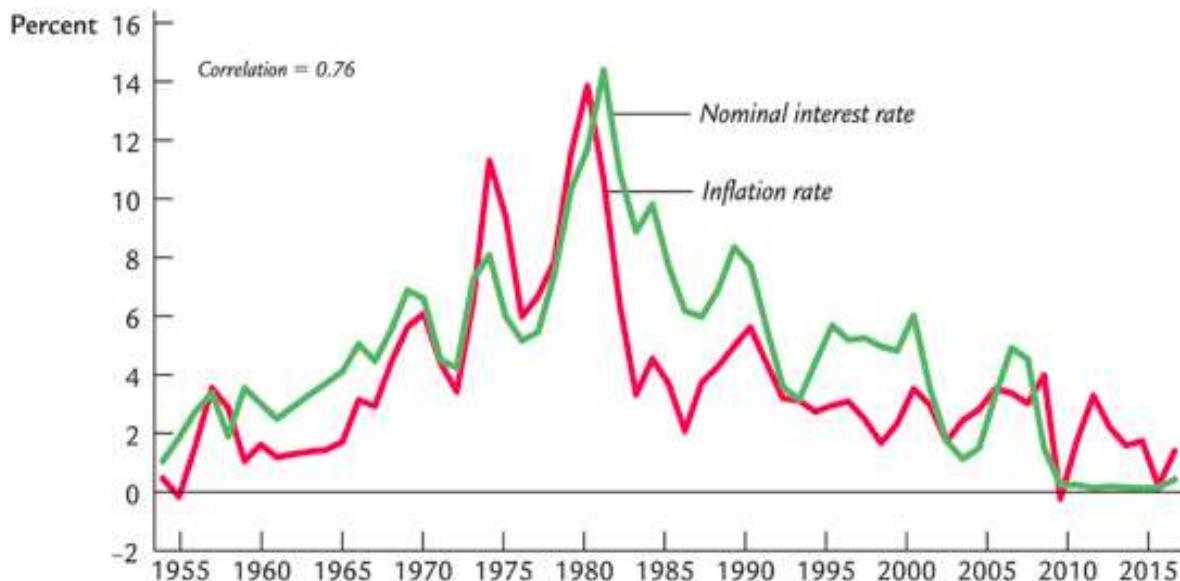


Figure: U.S. inflation rate (CPI) and nominal interest rate (TB3MS), 1955-2015

3. Social costs and effects

What would happen to households and firms if inflation has been an issue in the economy? Without perfect foresight, decision-makers must estimate future inflation rates ex ante but any estimation is subject to errors upon realization. Therefore, inflation can trigger expected and unexpected effects.

- 1) Effects of expected future inflation. What would you do if you know inflation rate will be exactly 2% next year?
 - a. Menu cost: businesses will adjust their price tags and menus.
 - b. Shoeleather cost: households and firms will tend to hold less cash and will need to go to their banks or ATM more often to withdraw small amount of cash (inflation reduces purchasing power and imposes “tax” and it pushes up market interest rates)

- c. Relative price distortion: the time lead and lag when businesses adjust their prices. Such distortion can cause confusing signals in the market economy.
 - d. Unfair tax treatment: some taxes, e.g. capital gain tax, do not adjust for inflation. For example, if your annual investment return is 5% and you must pay tax, though inflation rate is 5% and your real return is 0%.
- 2) Effects of unexpected future inflation: arbitrary redistribution of purchasing power. What would you do if you are not 100% sure about the inflation rate next year? What if you cannot sign long-term contracts offsetting inflation effects? In the case where financial contract is not indexed to inflation, if actual inflation rate is greater than expected inflation rate, the lenders lose and the purchasing power is transferred to the borrowers; if realized inflation rate is smaller than the expected inflation rate, the borrowers loses because they must pay the contract rate (expected rate) and the purchasing power is transferred to the lenders.
- 3) Inconvenience and uncertainty. When inflation is high, it's more variable and unpredictable: π turns out different from π^e more often, and the differences tend to be larger, though not systematically positive or negative. So, arbitrary redistributions of wealth are more likely.
- 4) One benefit of expected inflation. Moderate inflation may boost business sales and revenue. When nominal wage is fixed, inflation can temporarily reduce real wage and stimulate employment.

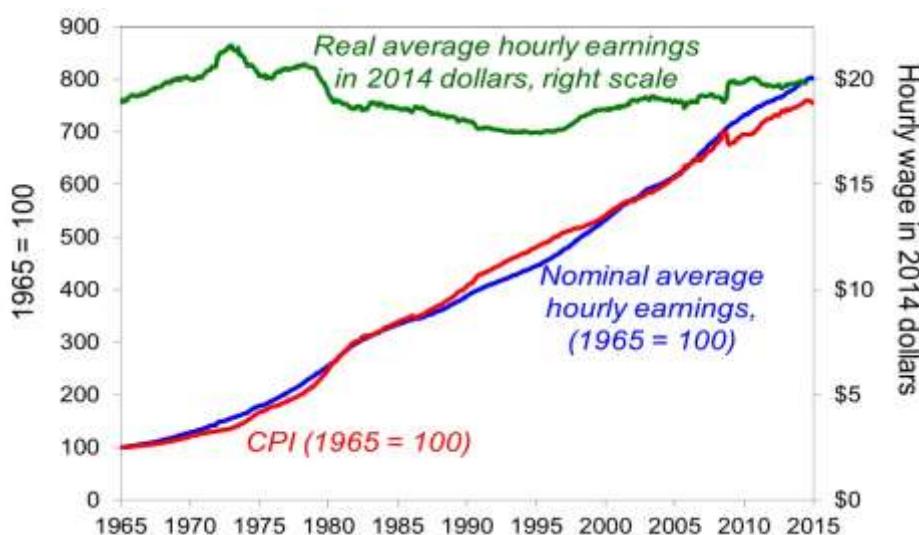


Figure: U.S. CPI and average hourly earnings, 1965–2015

In equilibrium, $w=W/P$, real wage=nominal wage/price=marginal product of worker. The CPI has risen tremendously over the past 45 years. However, nominal wages have risen by a roughly similar magnitude. If the common misperception were true, then the real wage should show exactly the opposite behavior of the CPI. It doesn't. While the real wage is not constant, it exhibits no downward long-term trend. We wouldn't expect the real wage to be constant over the long run; we would expect it to change in response to shifts in the labor supply and MPL curves.

Appendix

**The Hanke-Krus World Hyperinflation Table
(2013, Amended 10/2017)**

Location	Month with Highest Inflation Rate	Highest Monthly Inflation Rate	Time Required for Prices to Double
Hungary	Jul. 1946	$4.19 \times 10^{10}\%$	15.0 hours
Zimbabwe	Mid-Nov. 2008	$7.96 \times 10^{10}\%$	24.7 hours
Yugoslavia Republika Srpska	Jan. 1994	3130000000%	1.41 days
Germany	Oct. 1923	29500%	3.70 days
Greece	Oct. 1944	13800%	4.27 days
China	Apr. 1949	5070%	5.34 days
Free City of Danzig	Sep. 23	2440%	6.52 days
Armenia	Nov. 1993	438%	12.5 days
Turkmenistan	Nov. 1993	429%	12.7 days
Taiwan	Aug. 1945	399%	13.1 days
Peru	Aug. 1990	397%	13.1 days
Bosnia and Herzegovina	Jun. 1992	322%	14.6 days
France	Mid-Aug 1796	304%	15.1 days
China	Jun. 1945	302%	15.2 days
Ukraine	Jan. 1992	285%	15.6 days
Poland	Oct. 1923	275%	16.0 days
Nicaragua	Mar. 1991	261%	16.4 days
Congo (Zaire)	Nov. 1993	250%	16.8 days
Russia	Jan. 1992	245%	17.0 days
Bulgaria	Feb. 1997	242%	17.1 days
Moldova	Jan. 1992	240%	17.2 days
Venezuela	Nov. 2016	219%	17.9 days
Russia / USSR	Feb. 1924	212%	18.5 days
Georgia	Sep. 1994	211%	18.6 days
Tajikistan	Jan. 1992	201%	19.1 days
Georgia	Mar. 1992	198%	19.3 days
Argentina	Jul. 1989	197%	19.4 days
Zimbabwe	Oct. 2017	185%	20.1 days
Bolivia	Feb. 1985	183%	20.3 days
Belarus	Jan. 1992	159%	22.2 days
Kyrgyzstan	Jan. 1992	157%	22.3 days
Kazakhstan	Jan. 1992	141%	24.0 days
Austria	Aug. 1922	129%	25.5 days
Bulgaria	Feb. 1991	123%	26.3 days
Uzbekistan	Jan. 1992	118%	27.0 days
Azerbaijan	Jan. 1992	118%	27.0 days
Congo (Zaire)	Nov. 1991	114%	27.7 days
Peru	Sep. 1988	114%	27.7 days
Taiwan	Oct. 1948	108%	28.9 days
Hungary	Jul. 1923	97.90%	30.9 days
Chile	Oct. 1973	87.60%	33.5 days
Estonia	Jan. 1992	87.20%	33.6 days
Angola	May. 96	84.10%	34.5 days
Brazil	Mar. 1990	82.40%	35.1 days
Democratic Republic of Congo	Aug. 1998	78.50%	36.4 days
Poland	Jan. 1990	77.30%	36.8 days
Armenia	Jan. 1992	73.10%	38.4 days
Tajikistan	Nov. 1993	65.20%	42.0 days
Latvia	Jan. 1992	64.40%	42.4 days
Turkmenistan	Jan. 1996	62.50%	43.4 days
Philippines	Jan. 1944	60.00%	44.9 days
Yugoslavia	Dec. 1989	59.70%	45.1 days
Germany	Jan. 1920	56.90%	46.8 days
Kazakhstan	Nov. 1993	55.50%	47.8 days
Lithuania	Jan. 1992	54.00%	48.8 days
Belarus	Aug. 1994	53.40%	49.3 days
Taiwan	Feb. 1947	50.80%	51.4 days

Source: Hanke, Steve H., and Erik Bootrum. "Zimbabwe Hyperinflation, Again: The Sixth Episode of Hyperinflation in History." *Studies in Applied Economics* no. 30 (2017). Johns Hopkins Institute for Applied Economics, Global Health, and the Study of Business Enterprise, 19 Oct. 2017. Web. <<http://sites.krieger.jhu.edu/se/files/2017/10/Zimbabwe%20Hyperinflation,-Again-Hanke-Bootrum-Cover-Page-Paper.pdf>>.

<https://www.munknec.com/21-countries-have-experienced-hyperinflation-in-last-25-years-is-the-u-s-next/>

Readings

<https://inflationdata.com>

<https://howmuch.net/articles/timeline-us-history>

Average Annual Inflation Rates by Decade

<https://inflationdata.com/Inflation/Inflation/DecadeInflation.asp>

Federal Reserve Bank of Cleveland - Center for Inflation Research

<https://www.clevelandfed.org/en/our-research/center-for-inflation-research.aspx>

Zimbabwe and Hyperinflation: Who Wants to Be a Trillionaire?

Video <https://www.youtube.com/watch?v=78-BIZXm7wA>

How 9 Countries Saw Inflation Explode into Hyperinflation

<https://www.businessinsider.com/worst-hyperinflation-episodes-in-history-2014-4>

Buying Power of the U.S. Dollar Over the Last Century

<https://www.visualcapitalist.com/buying-power-us-dollar-century/>

*Inflation by Lawrence H. White

<https://www.econlib.org/library/Enc/Inflation.html>

Hyperinflation by Michael K. Salemi

<https://www.econlib.org/library/Enc/Hyperinflation.html>

*John H. Cochrane (2011): Inflation and Debt

<https://www.nationalaffairs.com/publications/detail/inflation-and-debt>

*Interest Rates by Burton G. Malkiel

<https://www.econlib.org/library/Enc/InterestRates.html>

Low Interest Rates Have Benefits ...and Costs (2011)

<https://www.stlouisfed.org/publications/inside-the-vault/spring-2011/low-interest-rates-have-benefits-and-costs>

Negative nominal interest rates for real? A true story in Switzerland

<https://fredblog.stlouisfed.org/2019/03/negative-nominal-interest-rates-for-real/>

The Great Inflation 1965-1982 https://www.federalreservehistory.org/essays/great_inflation

Robert J. Barro, "Inflation and Economic Growth," NBER Working Paper (October 1995).
<https://www.nber.org/papers/w5326>

Michael Bruno and William Easterly, "Inflation and Growth: In Search of a Stable Relationship," Federal Reserve Bank of St. Louis Review (May–June 1996).

Christopher J. Neely and Geoffrey E. Wood, "Deflation and Real Economic Activity Under the Gold Standard," Federal Reserve Bank of St. Louis Review, September/October 1995, pp. 27-37.
<https://doi.org/10.20955/r.77.27-37>

Silvio Contessi, Pierangelo De Pace, and Li Li, "An International Perspective on the Recent Behavior of Inflation," Federal Reserve Bank of St. Louis Review, Third Quarter 2014, pp. 267-294.
<https://doi.org/10.20955/r.96.267-294>

David Andolfatto and Andrew Spewak, "Understanding Lowflation," Federal Reserve Bank of St. Louis Review, First Quarter 2019, pp. 1-26. <https://doi.org/10.20955/r.101.1-26>

Lecture 9 Economic Growth Theory

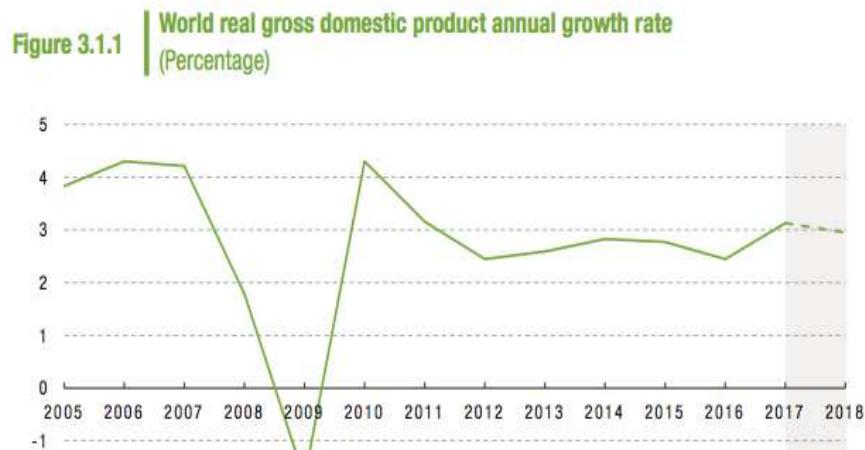
Biwei Chen (Updated: March 26)

Reference: Mankiw, 2019, CH8 Economic Growth I: Capital Accumulation and Population Growth

Topics: Economic growth facts and history. The Solow growth model. Why are some countries rich and others poor? What are some important factors driving economic growth?

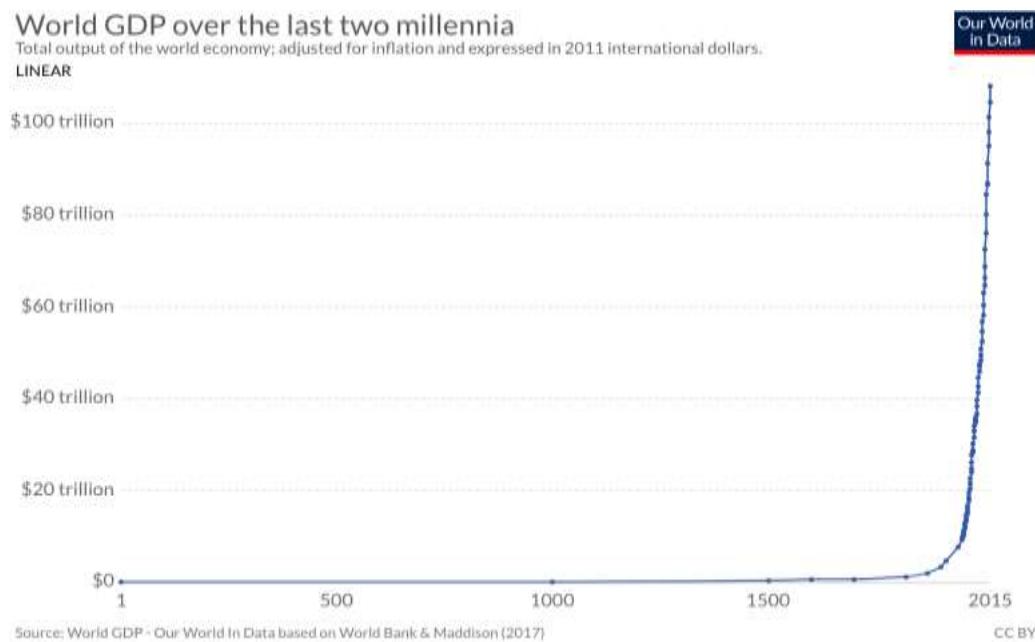
I. Definition and Measurements

1. Economic growth is the increase in economic output over time.
2. Measurements: real GDP growth rate and real GDP per capita growth rate
3. World real GDP growth <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>
4. Country ranking <http://statisticstimes.com/economy/countries-by-projected-gdp-growth.php>
5. 2018 world income map <http://datatopics.worldbank.org/sdgatlas/the-world-by-income.html>

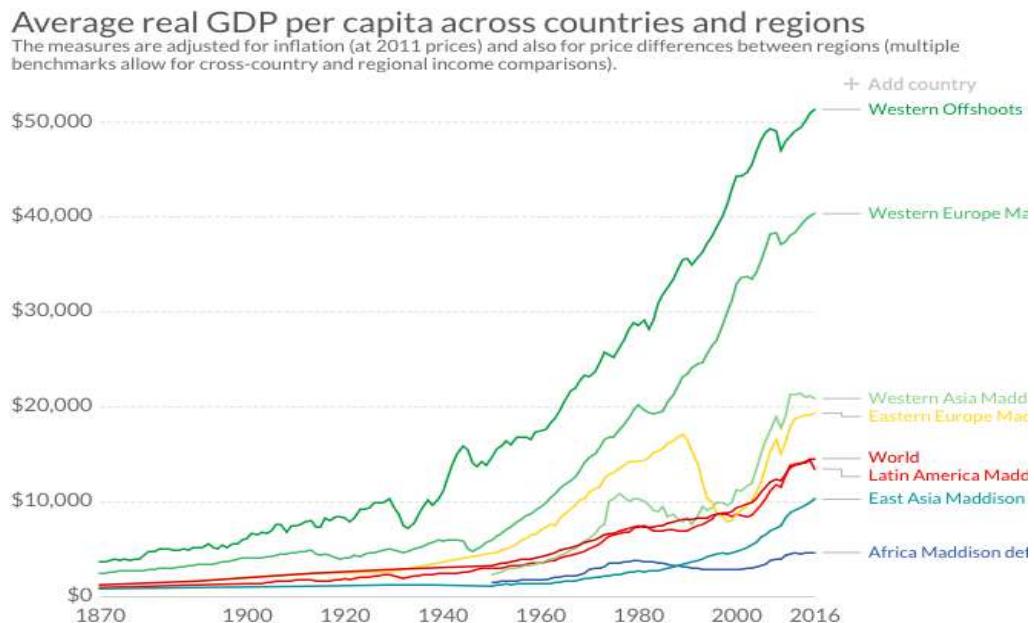


II. Historical Facts and Patterns

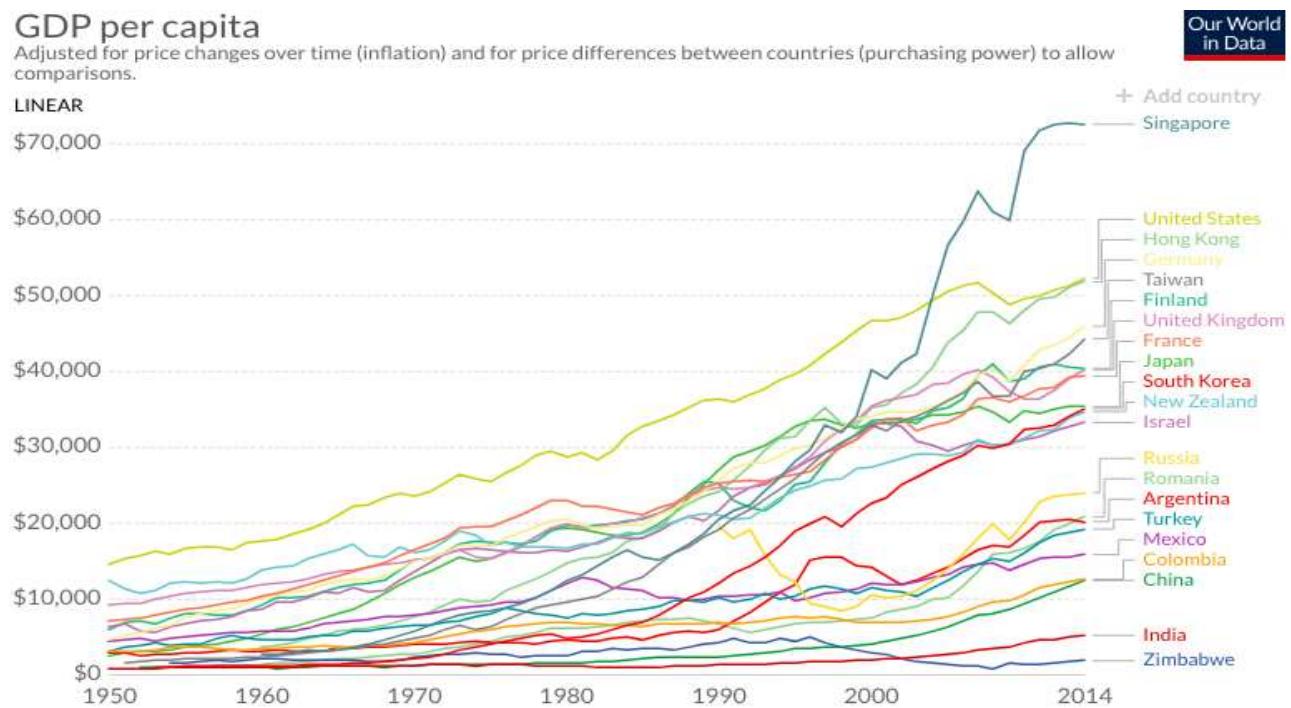
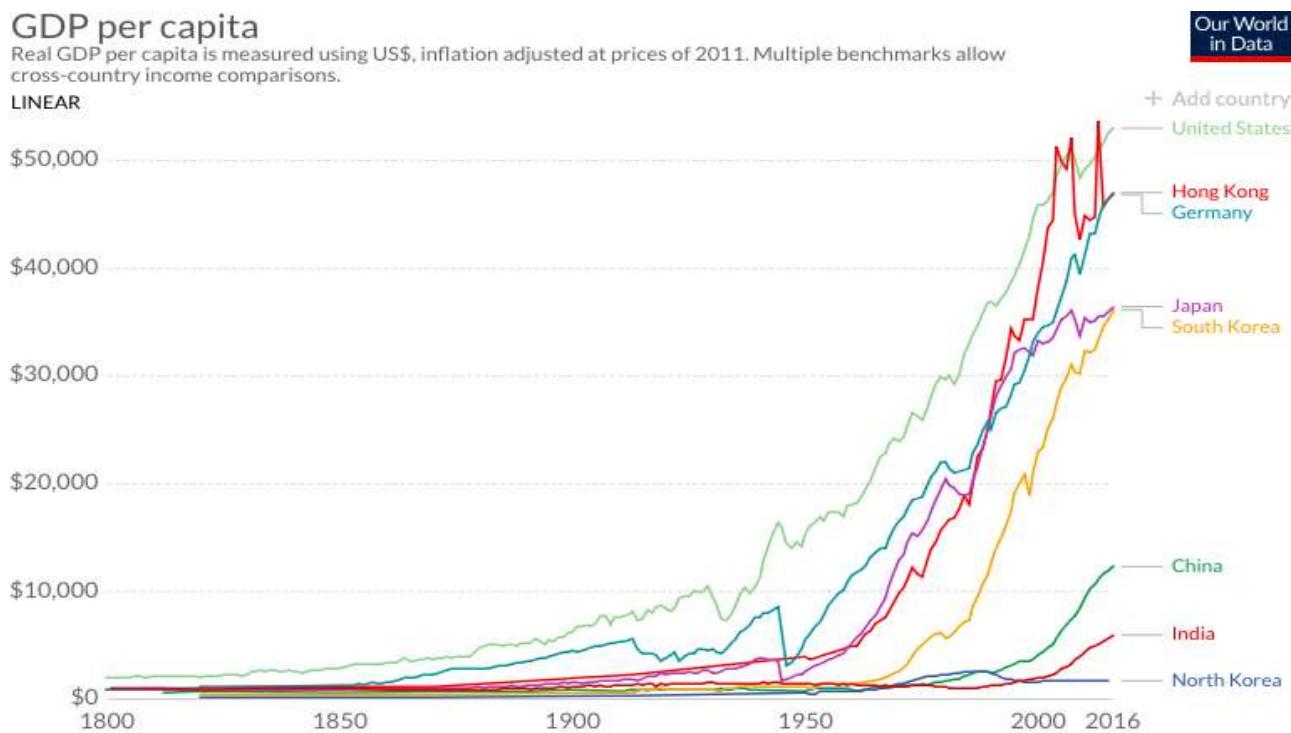
1. The 72 Rule: how long it takes for a value to double by dividing the growth rate into 72.
2. Compounding growth: a small difference in growth rate, a big difference in the long run!
3. Prosperity is a very recent achievement that distinguishes the last 10 or 20 generations from all of their ancestors. For all the hundreds, and really thousands, of years before 1820, the average GDP per capita was even lower. There was more than three quarters of two millennia economic stagnant.



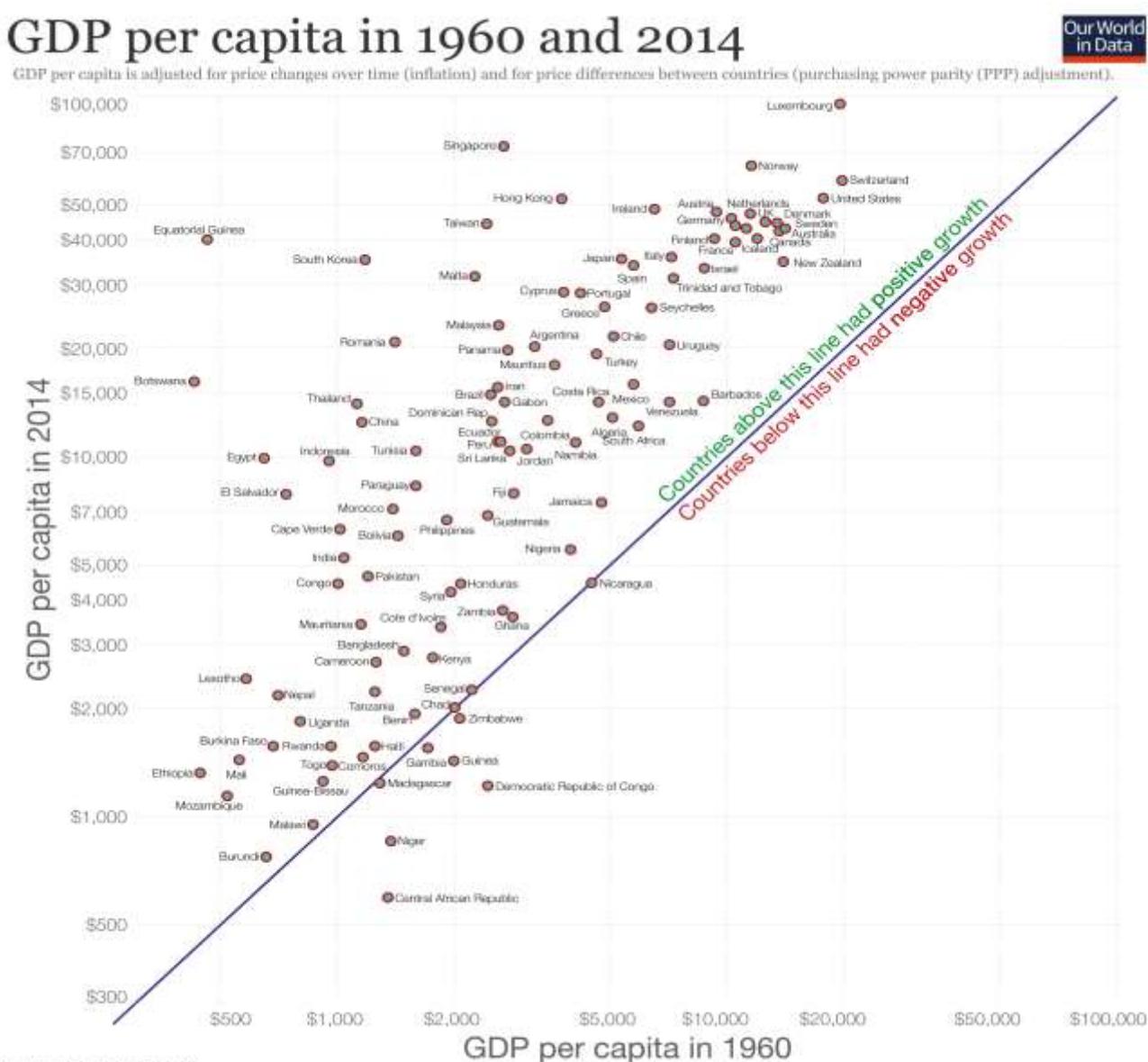
4. In 2016, the average GDP per capita was 14,574 international-\$ - more than 10-times the average of the past. In 1820 the global GDP per capita is estimated to be around 1,263 international-\$ per year and this is already after some world regions have achieved economic growth.



5. The U.S. GDP per capita at the eve of independence was still below \$2,000, adjusted for inflation and measured in prices of 2011 it is estimated to \$1,883. In 2016 – 240 years after independence – GDP per capita has increased more than 28-fold to \$53,015. From 1870 to 2016 GDP per person has grown on average at 1.83 percent per year with only very short deviations from this very steady trend. It is remarkable how steady economic growth was over this very long period.



6. The following chart plots, for each country, the national income in 1960 against the corresponding national income in 2014. GDP per capita are expressed in 'real terms', which means they are adjusted for inflation. In this chart, if incomes are stagnant, we should observe countries lining closely along the blue 45° line. Countries in which the income in 2014 is higher than the income in 1960 are above this 45° line. Some countries such as Madagascar, Chad, Senegal, and Nicaragua stagnated in terms of incomes – they are right on the 45 degree line. A couple of countries such as Niger and the Democratic Republic of Congo have even experienced negative growth over the period. But the large majority of countries, all those above the blue line, have experienced growth. Those countries that are far above the blue line had the strongest growth. Botswana (38-fold increase), South Korea (30-fold), Romania (15-fold), China (11-fold), and Thailand (18-fold) are some of the countries with the strongest growth over these 54 years.



III. Solow Growth Model <https://www.nobelprize.org/prizes/economic-sciences/1987/summary/>

The 1987 Nobel Prize in Economic Sciences was awarded to Robert M. Solow (M.I.T.) "for his contributions to the theory of economic growth."

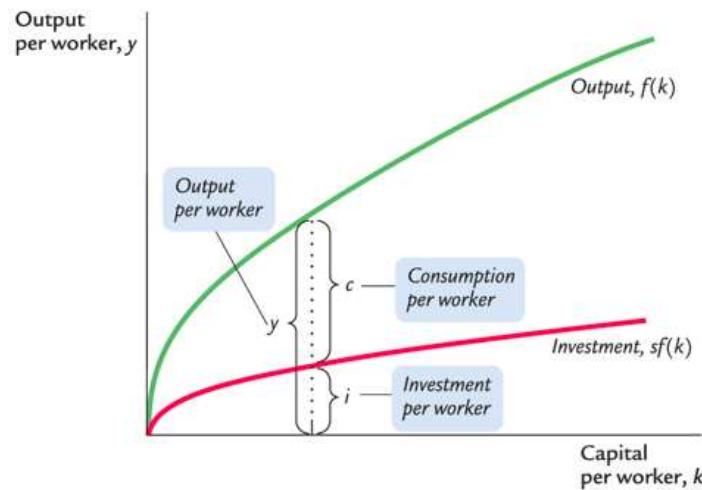
"Solow's growth model was presented in an article entitled, A Contribution to the Theory of Economic Growth (1956). The article contains a mathematical model (in the form of a differential equation) describing how increased capital stock generates greater per capita production. Solow's starting point is that society saves a given constant proportion of its incomes. The population and the supply of labor, grow at a constant rate and capital intensity (capital per employee) can be regulated. Capital intensity is determined by the prices of production factor. Due to diminishing yields, however, additional capital injections (increasing capital intensity) will make ever smaller contributions to production. This means that, in the long term, the economy will approach a condition of identical growth rates for capital, labor and total production (on condition that there is no technological progress). This involves a situation in which per capita production and real wage no longer increase. An increase in the proportion of incomes which is saved cannot, therefore, lead to a permanent increase in the rate of growth. In contrast, an economy with a higher savings ratio, experiences higher per capita production, and thus higher real income. But, in the absence of technological progress, the rate of growth will be the same, irrespective of the savings quotient, and will be purely dependent on an increased supply of labor. As a result, technological development will be the motor for economic growth in the long run. In Solow's model, if continuous technological progress can be assumed, growth in real incomes will be exclusively determined by technological progress. "

1. Assumptions

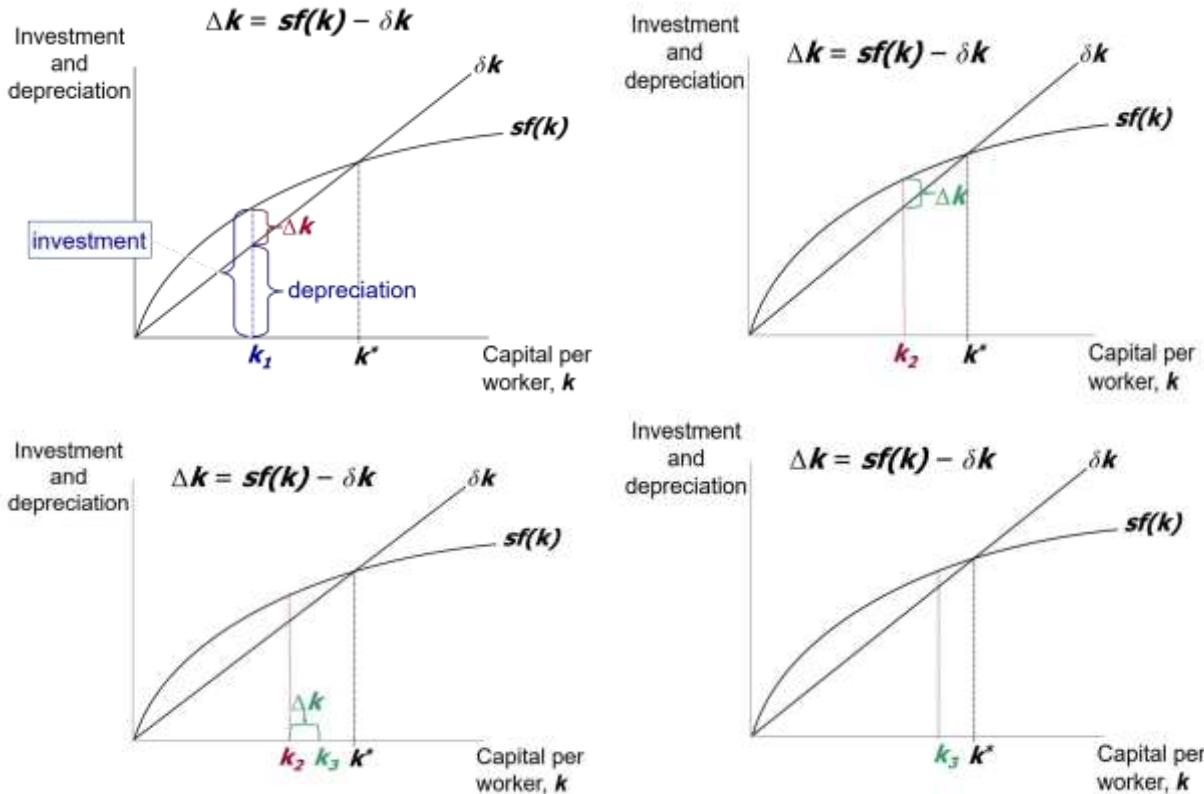
- 1) Production function: $Y=F(K, L)$, assuming constant return to scale or Cobb-Douglas form.
- 2) CRS: $y=Y/L=F(K/L, 1)=f(k)$, where y is output per worker and k is capital per worker.
- 3) Diminishing marginal products: $MPK=f(k+1)-f(k)$. $MPK>0$ and $MPK'<0$
- 4) No public sector and foreign countries. No G , T , and NX .

2. National income and capital accumulation

- 1) $Y=C+I$ and its per capita form $y=c+i$, where c and i are per capita consumption and investment.
- 2) Consumption and investment functions: $c=y-i=y-sy=y-sf(k)$, where s is the saving rate.



- 3) Income is derived from capital goods. Income growth is driven by capital accumulation.
- 4) Capital accumulation and depreciation: investment increases capital and depreciation reduces it.
- 5) Capital accumulation equation: $\Delta k = \text{investment} - \text{depreciation} = sf(k) - \delta k$, where δ is the capital depreciation rate (the fraction of the capital stock that wears out each period).
- 6) Steady-state capital stock k^* : the amount of capital per capita remains constant when $\Delta k = 0$.
- 7) Dynamic equilibrium and convergence: whenever $sf(k) > \delta k$ investment dominates depreciation, there will be capital accumulation. In the graphs below, k will increase from k_1 to k_2 to k_3 until at k^* . If $k > k^*$, capital depreciation outpaces investment, there will be capital stock reduction.



- 8) Numerical example: how the economy approaches steady-state

Assumptions : $y = \sqrt{k}$; $s = 0.3$; $\delta = 0.1$; initial $k = 4.0$

Year	k	y	c	i	δk	Δk
1	4.000	2.000	1.400	0.600	0.400	0.200
2	4.200	2.049	1.435	0.615	0.420	0.195
3	4.395	2.096	1.467	0.629	0.440	0.189
4	4.584	2.141	1.499	0.642	0.458	0.184
5	4.768	2.184	1.529	0.655	0.477	0.178
10	5.602	2.367	1.657	0.710	0.560	0.150
25	7.321	2.706	1.894	0.812	0.732	0.080
100	8.962	2.994	2.096	0.898	0.896	0.002
∞	9.000	3.000	2.100	0.900	0.900	0.000

Steady state equilibrium k^* , y^* , and c^* .

By setting $sf(k) - \delta k = 0$, plugging numbers to the equation, we can solve for the stars.

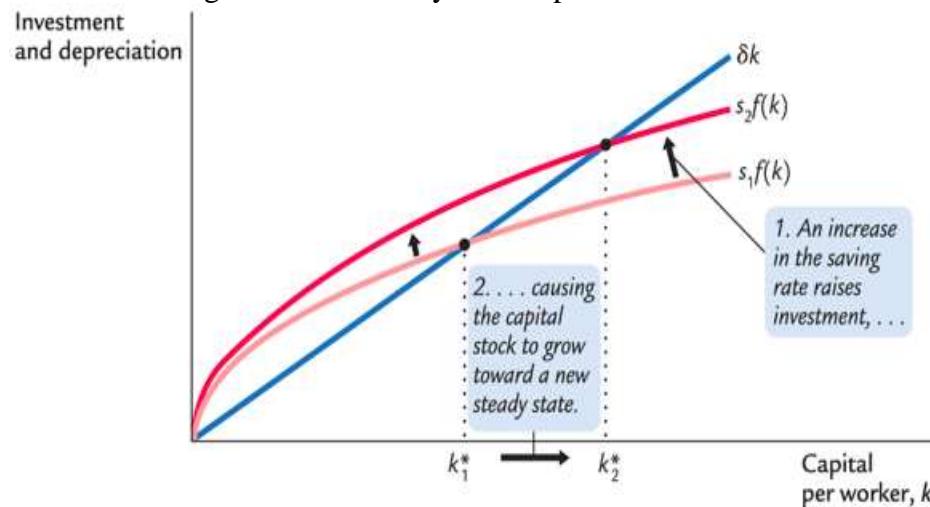
$$0.3f(k^*) = 0.1 * k^*$$

$$k^* = 9, \text{ and } y^* = 3$$

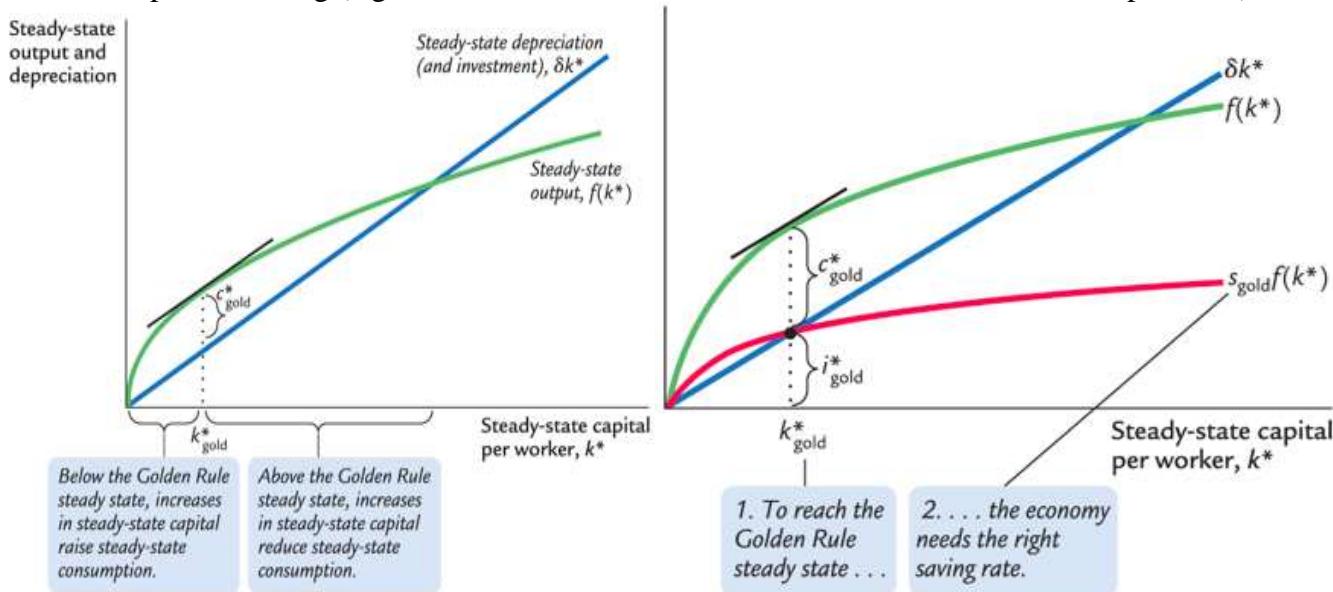
$$c^* = (1-s)y^* = 0.7 * 3 = 2.1$$

3. Economic growth and optimal consumption

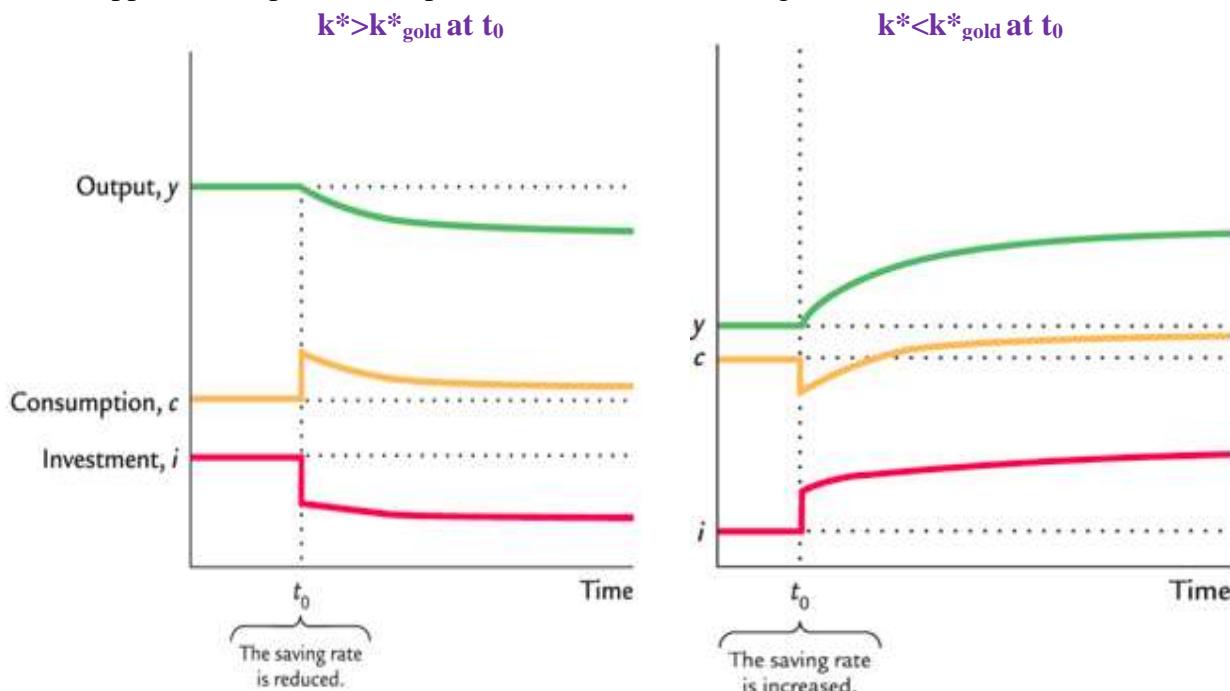
- 1) An increase in the saving rate raises steady-state capital and income level. Describe how.



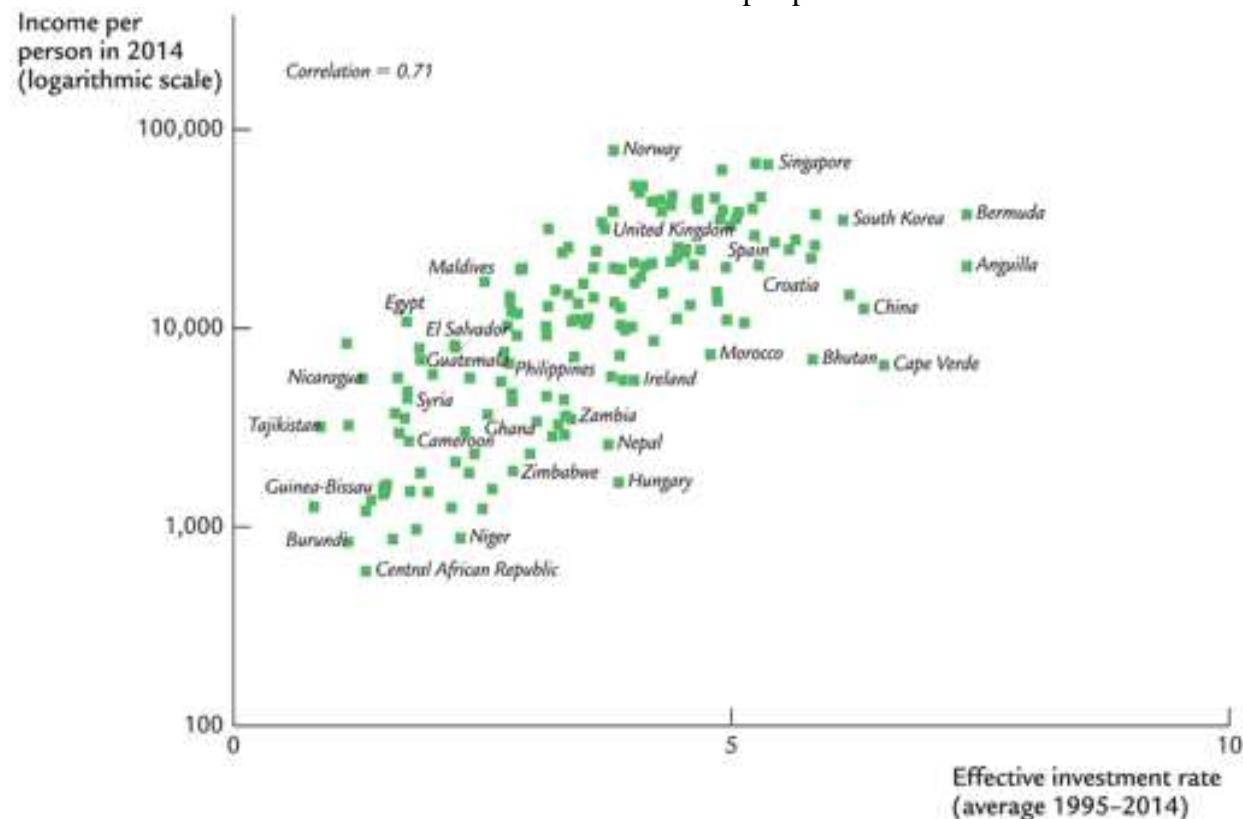
- 2) What would be the steady-state capital that maximizes consumption? The theoretical answer is called ***the golden rule level of capital k^*_{gold}*** . In the steady state, investment equals depreciation. Thus, steady-state consumption is the difference between output $f(k^*)$ and depreciation δk^* . Steady-state consumption is maximized c^*_{gold} at the Golden Rule level capital stock k^*_{gold} .
- 3) To identify k^*_{gold} , graph $f(k^*)$ and δk^* , look for the point where the gap between them is biggest.
- 4) Mathematically, we can solve the first-order condition $MPK^* = \delta$ for $c^* = f(k^*) - sf(k^*)$.
- 5) How to get there? **Different values of s lead to different steady states, given a depreciation rate.** An increase in s leads to higher k^* and y^* , which raises c^* ; *but it reduces consumption's share of income* ($1-s$), which lowers c^* . So, how do we find the s and k^* that maximize c^* ?
- 6) Public policy aiming to influence MPK can affect the national saving rate by changing G or T . Holding T constant overall but changing the structure of the tax system to provide more incentives for private saving (e.g., a revenue-neutral shift from the income tax to a consumption tax).



- 7) Example: Given $y = k^{1/2}$, the Golden Rule steady state occurs when $s = 1/2$. If the δ is 10 percent, then, at this equilibrium, $k^* = k^*_{\text{gold}} = 25$; $y^*_{\text{gold}} = 5$; and $c^*_{\text{gold}} = 2.5$
- 8) What happens to output, consumption, and investment during the transition to the Golden Rule?



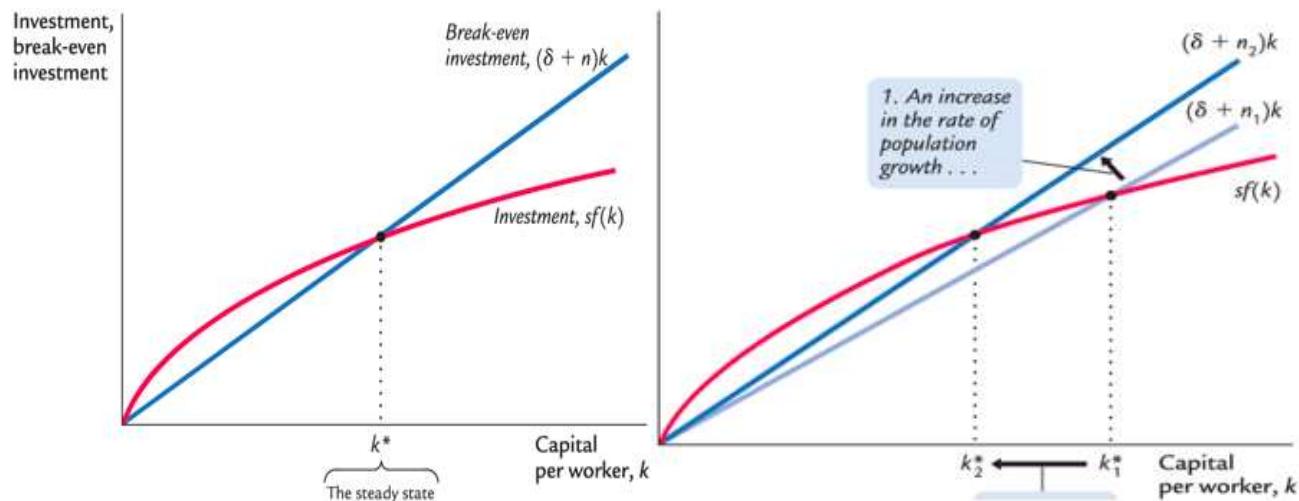
- 9) International evidence on investment rates and income per person



10) Case study on economic growth and convergence: At the end of World War II, the defeated countries of Japan and Germany were in poor economic shape because the war had destroyed a large part of their capital stocks. The Solow growth model predicts that, if a country is in steady state and then loses a lot of its capital, it will suffer an immediate loss in output but will also experience relatively rapid economic growth as it builds its capital stock back up to the steady-state level. This fits the experience of Japan and Germany in the decades immediately following World War II, when both countries exhibited very high growth rates in output per capita—8.0 percent per year in Japan and 6.5 percent per year in Germany over the period 1946–1972, compared with only 2.1 percent per year in the United States. Following their postwar growth spurt, both Japan and Germany transitioned to more moderate rates of growth, closer to that of the United States. Over the period 1972–2000, output per capita grew 2.4 percent per year in Japan and 1.8 percent per year in Germany, closer to the 1.8 percent per year rate for the United States.

4. Population growth and economic growth

- 1) Assume that the population and labor force grow at rate $n = \Delta L/L$ (exogenous):
- 2) In addition to replacing capital as it wears out, investment is made to equip additional workers, which further decreases capital per capita in the economy. $\Delta k = i - \delta k - nk = i - (\delta + n)k$. Therefore, an increase in population growth will lead to a lower steady-state capital and income level
- 3) **Break-even investment** $(\delta + n)k$ is the amount of investment necessary to keep k constant.
- 4) The Solow model predicts that countries with higher population growth rates will have lower levels of capital and income per worker in the long run. Is this prediction consistent with the data?
- 5) The Golden Rule with population growth: $c^* = f(k^*) - (n + \delta)k^*$ is maximized when $MPK = n + \delta$.



IV. Technological Progress in the Solow Model

Chapter 9 Economic Growth II: Technology, Empirics, and Policy. $Y=F(K, E^*L)$, where E is the efficiency level of labor.

Readings

Economic Growth by Max Roser

<https://ourworldindata.org/economic-growth>

Global Economic Inequality by Max Roser

<https://ourworldindata.org/global-economic-inequality>

Robert Merton Solow (1924-)

<https://www.econlib.org/library/Enc/bios/Solow.html>

Economic Growth by Paul M. Romer

<https://www.econlib.org/library/Enc/EconomicGrowth.html>

Economic Freedom by Robert A. Lawson

<https://www.econlib.org/library/Enc/EconomicFreedom.html>

Empirics of Economic Growth by Kevin Grier

<https://www.econlib.org/library/Enc/EmpiricsofEconomicGrowth.html>

Productivity by Alexander J. Field

<https://www.econlib.org/library/Enc/Productivity.html>

Standards of Living and Modern Economic Growth by John V. C. Nye

<https://www.econlib.org/library/Enc/StandardsofLivingandModernEconomicGrowth.html>

Economic Growth. Part I. Economic Growth and True Inequality by John V. C. Nye

<http://www.econlib.org/library/Columns/Nyegrowth.html>

Economic Growth. Part II. Irreducible Inequality by John V. C. Nye

<https://www.econlib.org/library/Columns/Nyepositional.html>

Chart of the Week: China's Thrift, and What to Do About It

<https://blogs.imf.org/2018/02/26/chart-of-the-week-chinas-thrift-and-what-to-do-about-it/>

FRBSF Economic Letter: 201906 Is Slow Still the New Normal for GDP Growth?

www.frbsf.org/economic-research/publications/economic-letter/2019/june/is-slow-still-new-normal-for-gdp-growth/

The Penn World Table (PWT) is a database on the level of incomes, output, input, and productivity over time. It is now covering more than 180 countries and data is available from 1950 onwards.

<https://www.rug.nl/ggdc/>

Lecture 8 Government Budget and Fiscal Policy

Biwei Chen (Updated: March 20)

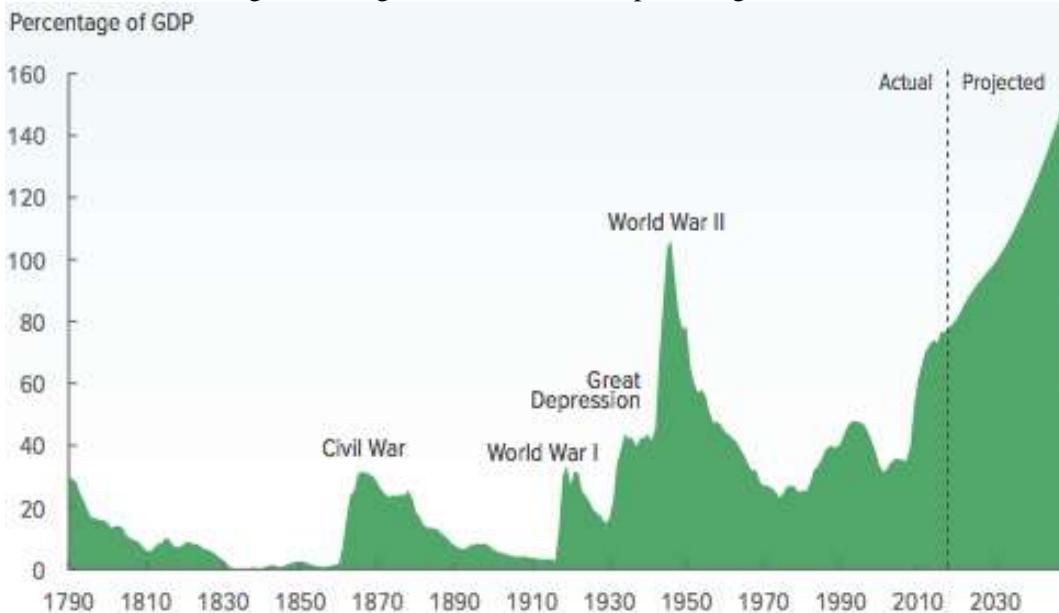
Reference: Mankiw, 2019, CH17 Government Debt and Budget Deficits

I. Facts and Statistics https://www.usgovernmentspending.com/debt_clock

US Treasury Monthly Report for September 2018: Total Federal Outlays: \$4.11 trillion; Total Federal Receipts: \$3.33 trillion; Federal Deficit: \$779 billion; Total Federal Debt: \$21.46 trillion

General government debt-to-GDP ratio is the amount of a country's total gross government debt as a percentage of its GDP. It is an indicator of an economy's health and a key factor for the sustainability of government finance. The United States recorded a government debt equivalent to 105.40 percent of the country's Gross Domestic Product in 2017. Government Debt to GDP in the United States averaged 61.70 percent from 1940 until 2017, reaching an all-time high of 118.90 percent in 1946 and a record low of 31.70 percent in 1981. <https://tradingeconomics.com/united-states/government-debt-to-gdp>

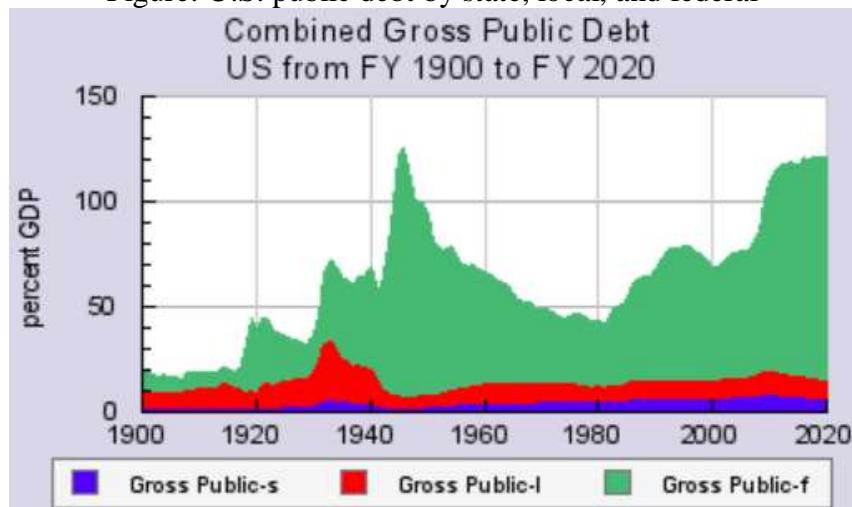
Figure: U.S. government debt as a percentage of GDP



Congressional Budget Office projects a 2019 deficit of about \$900 billion, or 4.2 percent of gross domestic product (GDP). The projected shortfall (adjusted to exclude the effects of shifts in the timing of certain payments) rises to 4.7 percent of GDP in 2029. Federal debt held by the public is projected to reach \$16.6 trillion at the end of 2019. Relative to the size of the economy, that amount—at 78 percent of GDP—would be nearly twice its average over the past 50 years. By 2029, debt is estimated to reach \$28.7 trillion, or 93 percent of GDP—a higher level than at any time since just after World War II. It would continue to grow after 2029, reaching about 150 percent of GDP by 2049.

As of March 2019, the Federal Debt is more than \$22 trillion. But, it doesn't include state and local debt. And, it doesn't include so-called "agency debt." And, it doesn't include the so-called unfunded liabilities of entitlement programs like Social Security and Medicare. Federal Debt per person is about \$67,511.

Figure: U.S. public debt by state, local, and federal



However, relative to GDP, the U.S. government's debt is moderate compared to that of other countries. Why has been so much worry and debate about debt limits? You can find answers from the article here. <https://www.brookings.edu/blog/up-front/2019/01/04/the-hutchins-center-explains-how-worried-should-you-be-about-the-federal-debt/>

Figure: 2015 Government debt as a percentage GDP <https://data.oecd.org/gga/general-government-debt.htm>

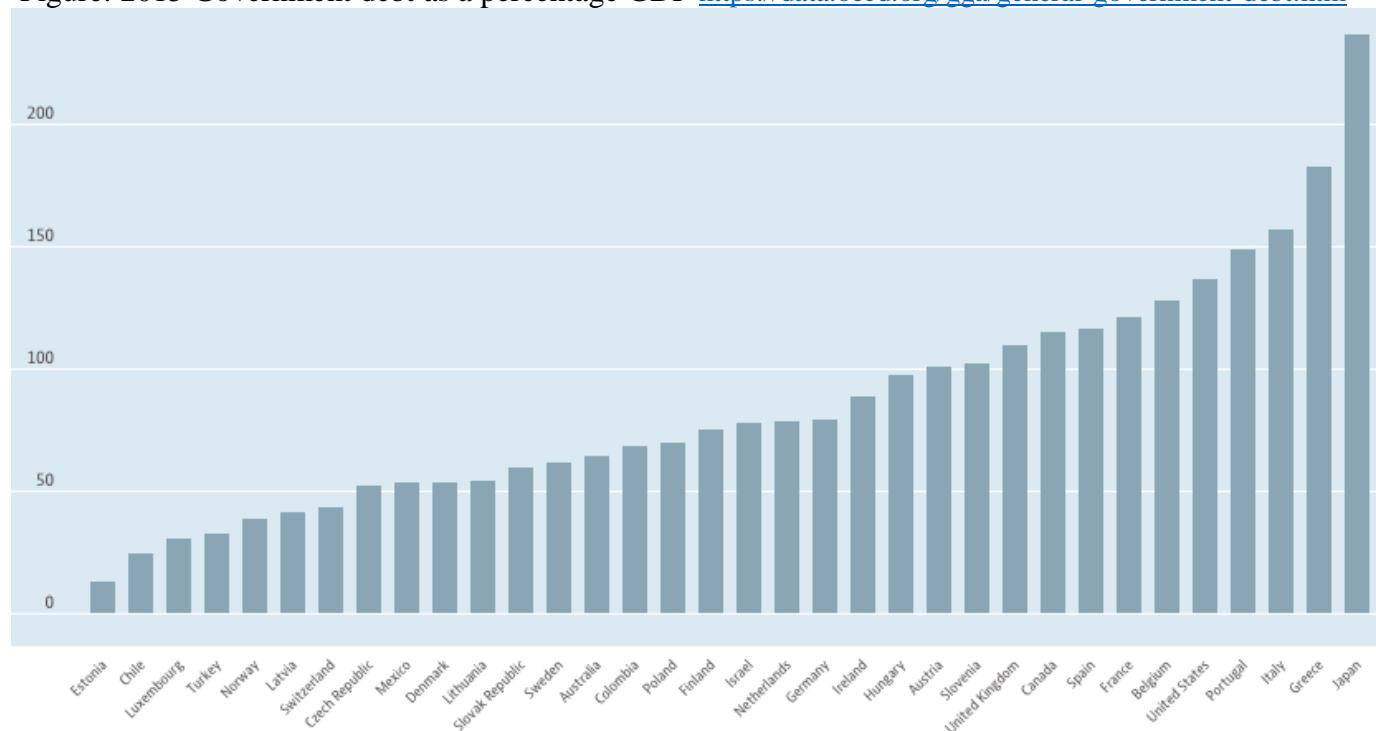
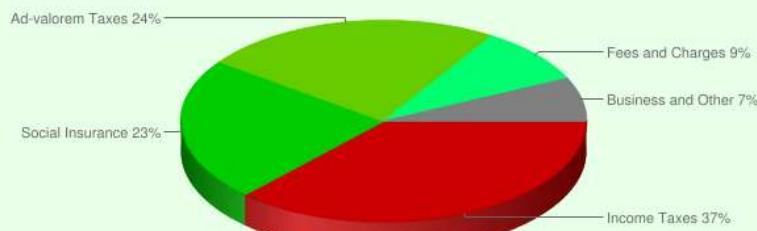
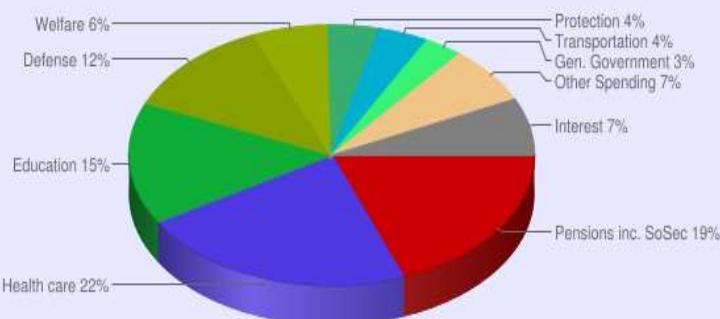


Figure: 2019 Total US government revenue and spending

Total Revenue: \$6.56 trillion for - FY 2019



Total Spending: \$7.65 trillion for - FY 2019

**Spending and Revenues in the Past and in CBO's Extended Baseline**

Percentage of Gross Domestic Product

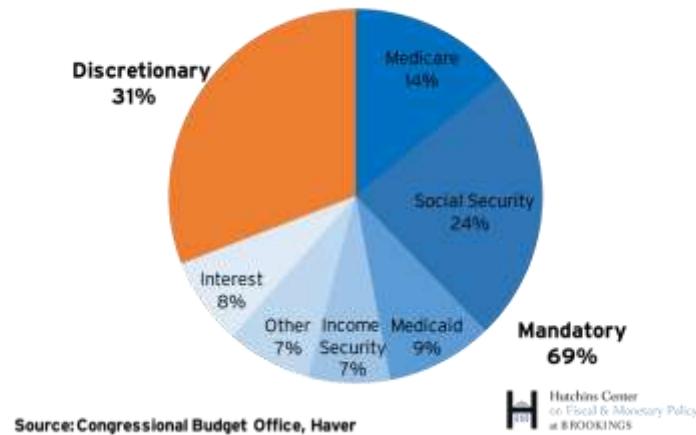


II. Government Expenditure (\$4.11T in 2018FY)

1. Mandatory spending (69% in the fiscal year of 2018)

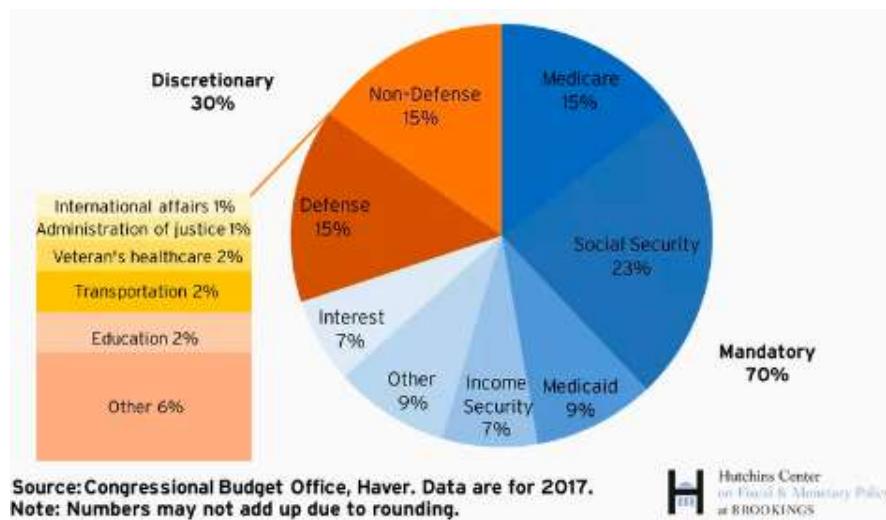
- 1) Social security: pays a monthly old-age benefit to those reaching retirement age (minimum 62)
- 2) Medicare: pays for the health care expenses for those 65 and older
- 3) Medicaid: health care program for the poor run jointly by the state and federal governments
- 4) Income security programs (unemployment insurance, food stamps, etc.)
- 5) Others smaller programs (federal government and military retirees' benefits, veteran pension)
- 6) Interest payments (8%) on the federal debt (\$15+ trillion in 2018, roughly 76% of the GDP)

COMPOSITION OF MANDATORY SPENDING (2018)



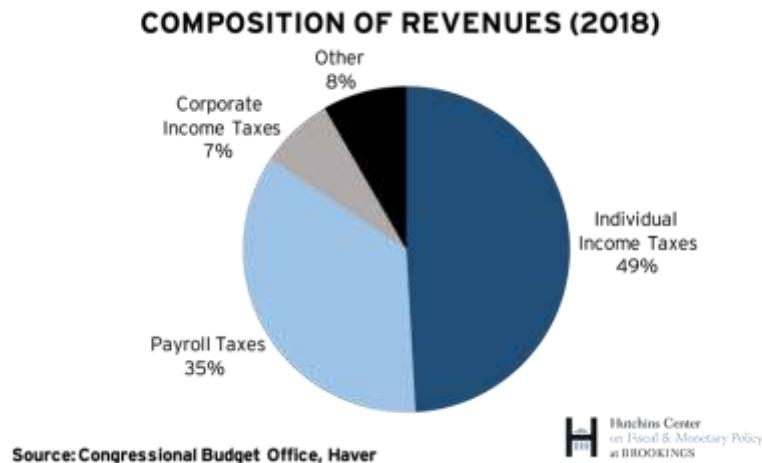
2. Discretionary spending: determined by Congress (31% in the fiscal year of 2018)

- 1) Defense: In 2017, it exceeded that of the next seven countries combined. It accounted for over a third of worldwide defense spending.
- 2) Non-defense: space exploration, education (most public spending on education is at the state and local level), training, employment, transportation, international affairs (international development and humanitarian assistance, international military assistance), FBI, housing assistance.
- 3) Other public infrastructure such as highways, bridges, disaster relief.



III. Government Revenue (\$3.33T in 2018FY)

1. In 2018, federal revenues amounted to \$3.33 trillion. Most of that came from individual income taxes (49%) and the payroll taxes levied to finance Social Security and Medicare (35%). The remainder came from the corporate income tax (7%) and a hodgepodge of other taxes (9%) including the estate and gift taxes and taxes on alcohol, tobacco and firearms (excise taxes).
2. In 2018, the top 20% of earners received 53% of all income before taxes and paid 68% of all federal taxes. Within this top 20%, the top 1% of earners paid 26% of all federal taxes while receiving 16% of total pre-tax income, and the top 0.1% paid slightly more than 13% of all taxes and received a pre-tax income share of about 8%.



IV. Fiscal Policy Theory

Fiscal policy is how the government decides to tax and spend in response to economic conditions.

Expansionary fiscal policy	Contractionary fiscal policy
Increase government spending	Decrease government spending
Decrease taxes	Increase taxes
Increase government spending and taxes equally	Decrease government spending and taxes equally

1. Government budget constraints: $G_t + V_t + i_{t-1}B_{t-1} = T_t + (M_t - M_{t-1})$

Purchases+ Transfers+ Interest Payments=Taxes+ Revenue from money creation

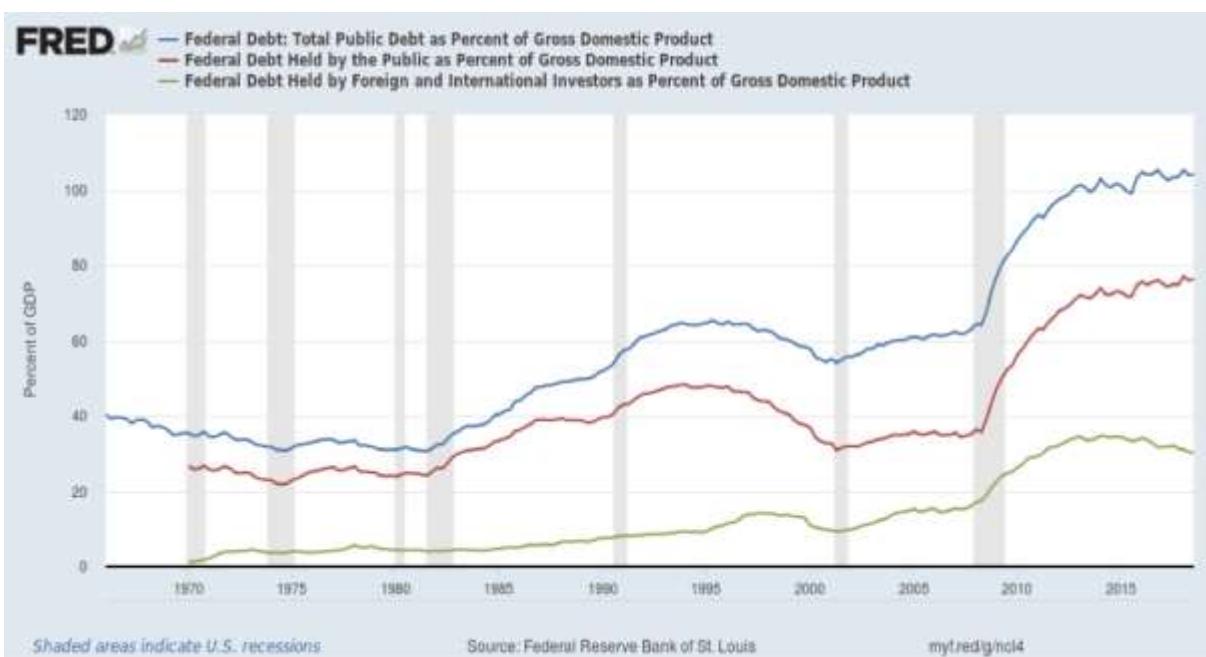
2. Can Uncle Sam go bankrupt?

- 1) Reasons to worry: If households and firms persistently operate in the red, they will go bankrupt sooner or later. Those who view government debt as being similar to privately held debt are concerned that government debt may be fast approaching a level that could result in government being unable to repay its debt.
- 2) Reasons to relieve: The U.S. government will not go bankrupt because it never has to pay off its debt. When government securities mature, the U.S. Treasury can refinance, or roll over, the debt by issuing new securities.

3. In the traditional view, a debt-financed tax cut increases consumption and reduces national saving. In a closed economy, this leads to higher interest rates, lower investment, and a lower long-run standard of living. In an open economy, it causes an exchange rate appreciation and a fall in net exports (or an increase in the trade deficit).
4. The Ricardian view holds that debt-financed tax cuts do not affect consumption or national saving and therefore do not affect interest rates, investment, or net exports.
5. Most economists oppose a strict balanced budget rule, as it would hinder the use of fiscal policy to stabilize output, smooth taxes, or redistribute the tax burden across generations.
6. The government has built-in economic policies and programs called **automatic stabilizers** that buffer changes in the economy. When the economy changes—in either direction—these stabilizers automatically adjust taxes and spending without new legislation. For example, progressive income tax and unemployment insurance.

7. Domestic and Foreign debt

- 1) International national debt: the portion of the national debt owed to a nation's own citizens.
- 2) External national debt: the portion of the national debt owed to foreign citizens.



8. Government deficit and debt can have other effects:

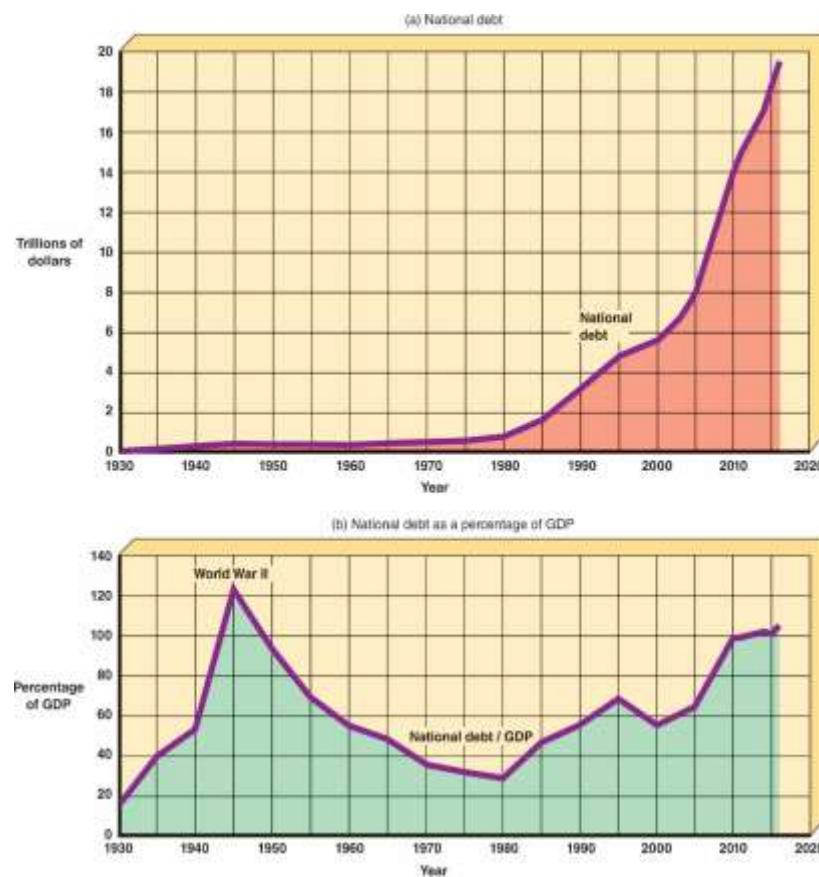
- 1) Fiscal policy effect on real GDP growth: the Hutchins Center Fiscal Impact Measure shows how much fiscal policy adds to or subtracts from overall economic growth
<https://www.brookings.edu/interactives/hutchins-center-fiscal-impact-measure/>

- 2) Crowding-out effects: A reduction in private-sector spending as a result of federal budget deficits financed by U.S. Treasury borrowing; when federal government borrowing increases interest rates, the result is lower household consumption and lower business investment.
- 3) Crowding-in effect: An increase in private-sector spending as a result of federal budget deficits financed by U.S. Treasury borrowing; at less than full employment, consumers hold more Treasury securities and this additional wealth causes them to spend more; business spending increases because of optimistic profit expectations
- 4) It may lead to runaway inflation if the government finances their debt by printing too much M.
- 5) Politicians can shift the burden of taxes from current to future generations.
- 6) It may reduce the country's political clout in international affairs or scare foreign investors into pulling their capital out of the country.

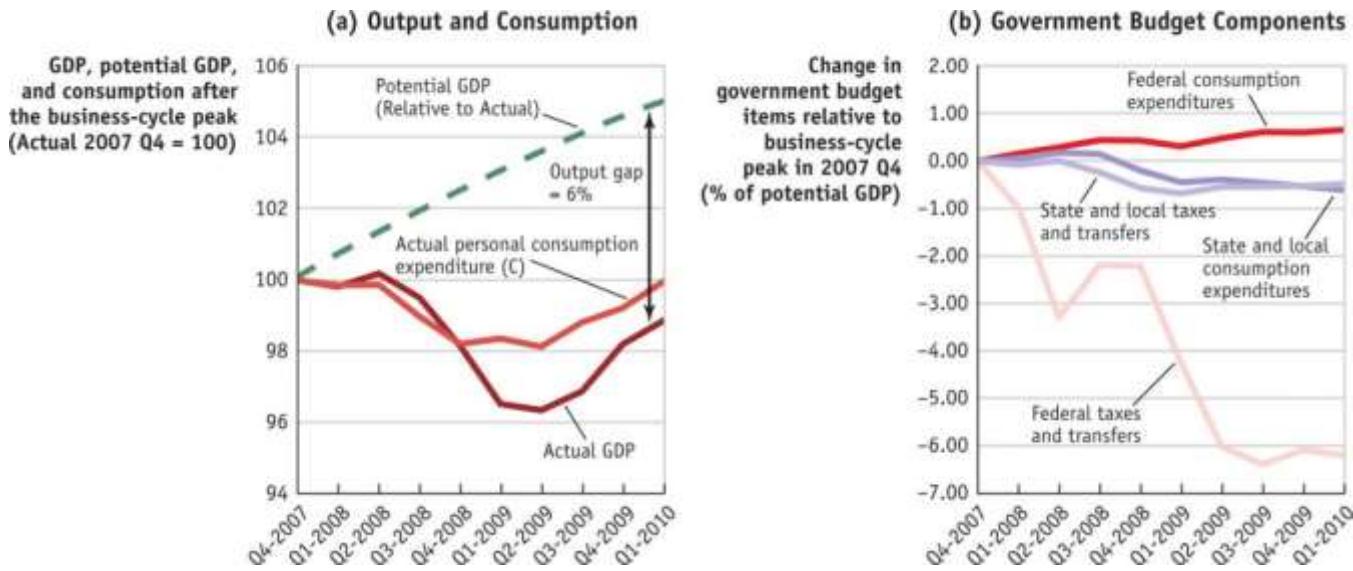
9. Macroeconomic policy effects: comparison

Government Policy	Change in M	Change in gov bonds	Change in Taxes
1. Print money and reduce taxes	+M	0	-T
2. Raise taxes and reduce public debt	0	-B	+T
3. Open-market purchase of gov bonds	=M	-B	0

Note: policy 3 is amounts to a combination of policies 1 and 2.



V. U.S. Fiscal Policy in the Great Recession



1. In the U.S. economic slump of 2008–2010, output had fallen 6% below the estimate of potential level
2. of GDP by the first quarter of 2009, as seen in panel (a). This was the worst U.S. recession since the 1930s. Policy responses included automatic fiscal expansion (increases in spending and reductions in taxes), plus an additional discretionary stimulus.
3. And on the government spending side, there was no stimulus at all in the aggregate: Increases in federal government expenditure were fully offset by cuts in state and local government expenditure, as seen in panel (b).
4. The aggregate U.S. fiscal stimulus had four major weaknesses:
 - 1) It was rolled out too slowly, due to policy lags.
 - 2) The overall package was too small, given the magnitude of the decline in aggregate demand.
 - 3) The government spending portion of the stimulus, for which positive expenditure effects were certain, ended up being close to zero, due to state and local cuts.
 - 4) This left almost all the work to tax cuts, that recipients, for good reasons, were more likely to save rather than spend.

With monetary policy impotent and fiscal policy weak and ill designed, the economy remained mired in its worst slump since the 1930s Great Depression.

Readings

Fiscal Policy with John Taylor

<https://www.policyed.org/econ1>

American's debt explained in 10 visualizations

<https://howmuch.net/articles/americas-debt-explained-in-10-visualizations>

U.S. Government Budget Data

<https://fred.stlouisfed.org/categories/5>

<https://www.usgovernmentrevenue.com>

<https://www.usgovernmentspending.com>

https://www.usgovernmentdebt.us/debt_deficit_history

Introduction to Fiscal Policy - The Economic Lowdown Podcast Series, Episode 21

<https://www.stlouisfed.org/education/economic-lowdown-podcast-series/episode-21-fiscal-policy>

IMF Blog: New Data on Global Debt

<https://blogs.imf.org/2019/01/02/new-data-on-global-debt/>

IMF Blog: Bringing Down High Debt

<https://blogs.imf.org/2018/04/18/bringing-down-high-debt/>

IMF Blog: The Wealth of Nations - Governments Can Better Manage What They Own and Owe

<https://blogs.imf.org/2018/10/09/the-wealth-of-nations-governments-can-better-manage-what-they-own-and-owe/>

Fiscal Therapy: 12 framing facts and what they mean

<https://www.brookings.edu/research/fiscal-therapy-12-framing-facts-and-what-they-mean/>

Five myths about federal debt <https://www.brookings.edu/opinions/five-myths-about-federal-debt/>

The Hutchins Center Explains: The debt limit

<https://www.brookings.edu/blog/up-front/2019/03/15/the-hutchins-center-explains-the-debt-limit/>

The Hutchins Center Explains: Federal budget basics

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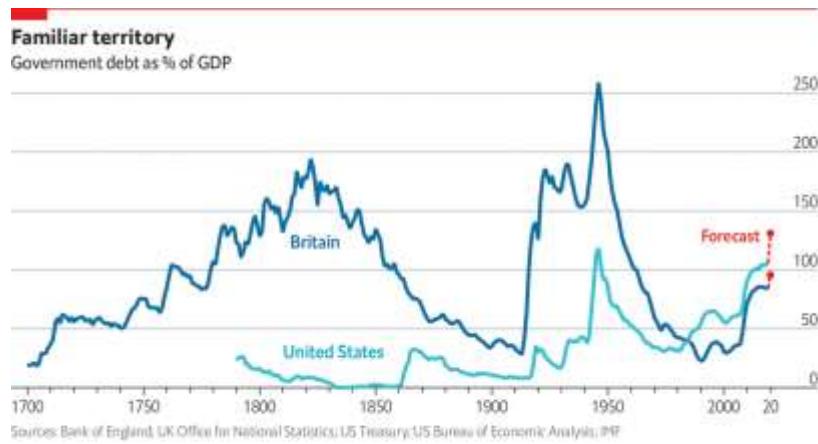
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Lecture 7 Monetary Theory and Policy

Biwei Chen (Updated: March 17)

Reference: Mankiw, 2019, CH4 The Monetary System & CH5.4 Demand for Money

I. Money: Functions and Types

1. Definition: Money is the stock of assets that can be readily used to make transactions.
2. Anything serves as a universal medium of exchange can be defined as money. All the other functions of money are derived afterwards.
3. Properties: 1) fungible; 2) durable; 3) divisible; 4) portable; 5) acceptable; 6) scarce; 7) uniform.
4. Money, as a medium of exchange, evolves from society's persistent endeavor to reduce transaction cost; as a unit of account, it measures the value of the goods and services being exchanged in terms of monetary units; as a store of value, money enables its owner to finance inter-temporal exchange, balancing consumption, saving, and investment over time.
5. Which of these are money? 1) checks; 2) deposits with checking/savings accounts; 3) credit cards; 4) debt cards; 5) certificates of deposit (CDs); 6) Bitcoin; 7) gold and silver; 8) WeChat Pay.
6. Evolution: commodity money, paper money, fiat money (legal tender), virtual/digital money.

II. Money: Measurements and Statistics in the U.S.

1. M1 includes funds that are readily accessible for spending. M1 consists of: (1) currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions; (2) traveler's checks of nonbank issuers; (3) demand deposits; and (4) other checkable deposits (OCDs), which consist primarily of negotiable order of withdrawal (NOW) accounts at depository institutions and credit union share draft accounts. <https://fred.stlouisfed.org/series/M1>
2. M2 includes a broader set of financial assets held principally by households. M2 consists of M1 plus: (1) savings deposits (which include money market deposit accounts, or MMDAs); (2) small-denomination time deposits (time deposits in amounts of less than \$100,000); and (3) balances in retail money market mutual funds (MMMFs). <https://fred.stlouisfed.org/series/M2>

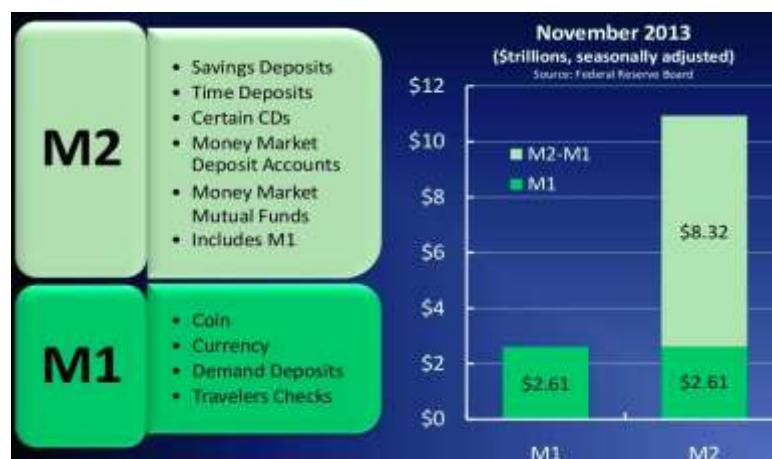
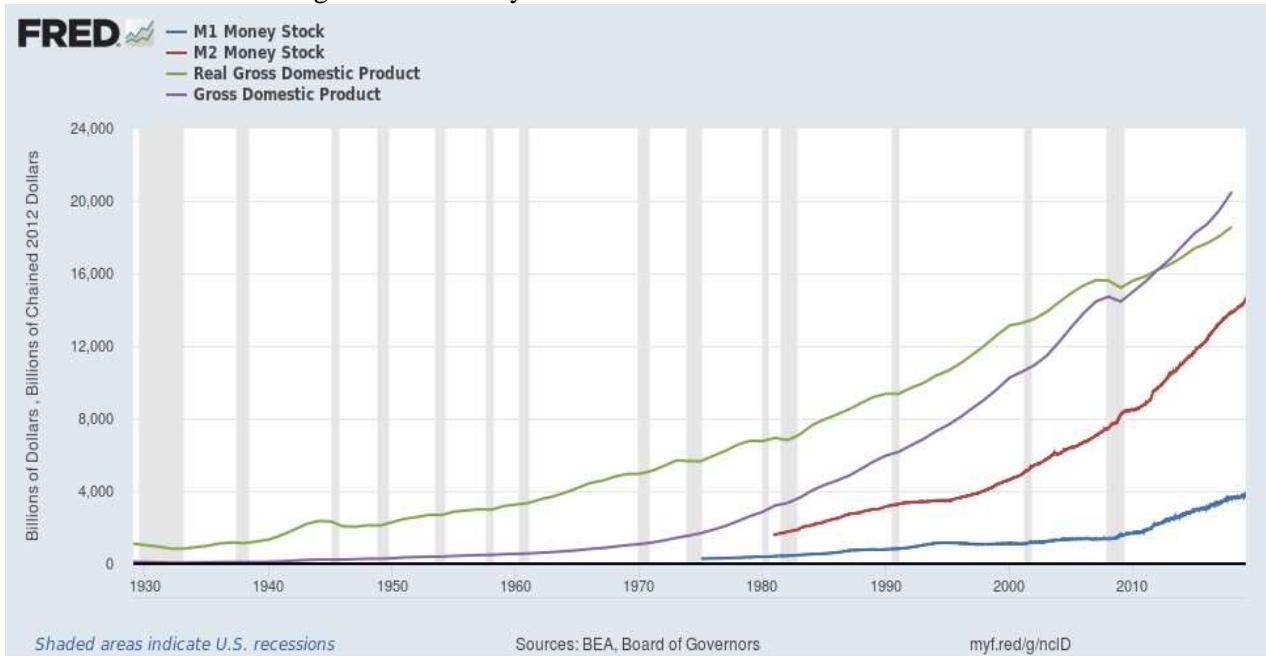


Figure: U.S. Money Stock Measures and GDP 1929-2019



III. Money Demand and Supply (Ch5.4)

1. Transaction demand: $Md = kPQ$. Demand for money is derived from the demand for goods and services. It is related to the quantity equation $MV=PQ$ by $k=1/V$ in equilibrium. Note that demand for money is negatively related to the transaction velocity of money. Why? Because people do not need that much money for transactions if less money are changing hands more rapidly.
2. Liquidity demand: $Md = L(i, Q) = L(r + \pi^e, PQ)$, which depends negatively on the nominal interest rate (opportunity cost of holding money). People hold cash simply because it is useful for most immediate transactions but hoarding cash has a cost—it does not provide any interest.
3. When nominal interest rate goes up, people deposit more money in the bank to earn interest and need less cash for imminent transactions. Therefore, the velocity of money will go up as less amount of cash would be used more frequently to facilitate transactions.
4. While investment and consumption depend on the real rate of interest, money demand (liquidity preference) depends on the nominal rate of interest.
5. Real money balance: Md/P , measures the purchasing power of money in terms of quantity goods.
6. Money supply is jointly determined by the central bank and by commercial banks and depositors. In most macroeconomic analysis, it is assumed to be an exogenous variable and tightly determined by the central bank's monetary policy.

IV. Money and Banking

1. Commercial banks: balance sheet
 - 1) Assets (use of fund): cash and other reserves, loans, securities
 - 2) Liabilities (source of fund): deposits, debts, bank capital (owners' equity)
 - 3) Accounting identity: $\text{Total Assets} = \text{Total Liabilities} + \text{Owners' Equity}$

<https://www.nasdaq.com/symbol/jpm/financials?query=balance-sheet>

- 4) The role of bank capital is to avoid excess risk taking and help the bank remain solvent. It serves as buffer to and cushion against macroeconomic and business shocks (shock absorber).
 - 5) Leverage: the use of borrowed money to supplement existing funds for purposes of investment.
 - 6) Leverage Ratio=Total Assets/Owners' Equity. What is the leverage ratio in the example below? Answer: $50/1000=5\%$. What happens to the bank if a recession wipes out 10% of the loans? Due to a loss of \$50 when borrowers could not pay back their loans, the bank owner must use their own capital to cover the loss, which wipes out \$50 owners' equity. As a result, the bank will declare bankruptcy if there is no new capital raised.

Assets	Assets	Liabilities and owners' equity	Liabilities and owners' equity
Reserves	\$200	Deposits	\$750
Loans	500	Debt	200
Securities	300	Capital (owners' equity)	50

2. Money and credit creation in the banking system

- 1) Fractional reserve system: commercial banks are required to hold a fraction of their deposits as reserves deposited at the central bank. After meeting their depositors' daily demand and regulatory requirements, the bankers can do businesses by financing loans and investments.
 - 2) The banking system can create “new money” by accepting new deposits and issuing new loans and so on and on. If all depositors hold some cash as a fraction of their deposits, then for each new deposit, there will be less funds available for new loans, resulting in less amount of total money and credit in the banking system.
 - 3) Deposit creation model: bank A receives \$1000 initial deposit and holds 10% as required reserve. Suppose there is no cash withdrawn in the process. What would be the total amount of money and credit available in the banking system? $M=D_1/rr$, where rr is the reserve ratio.

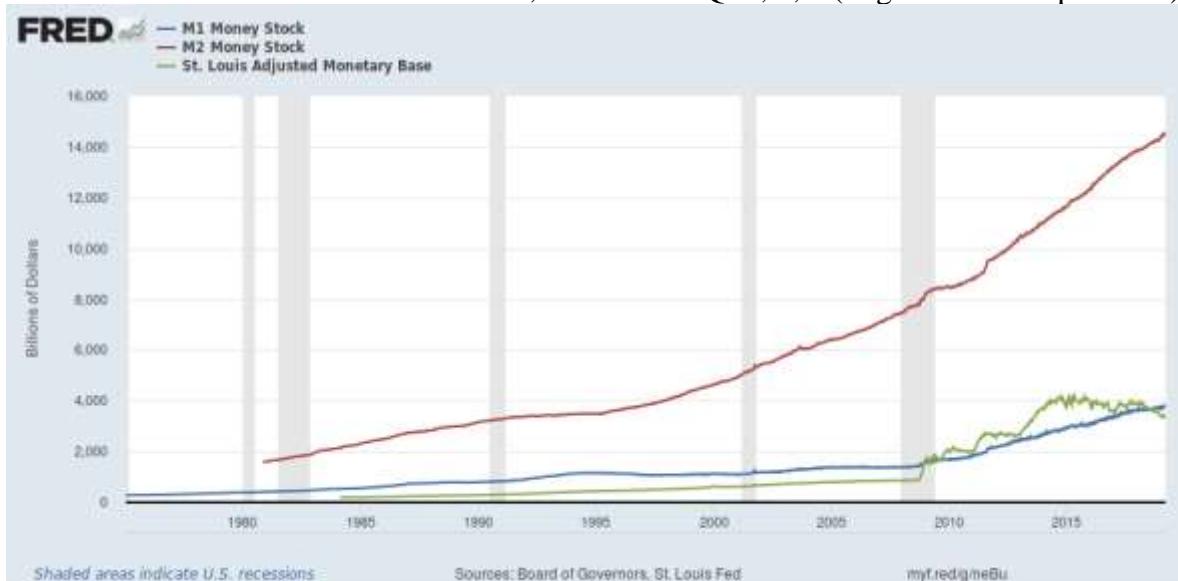
Bank A		Bank B	
Asset	Liabilities	Assets	Liabilities
\$100 Reserves	\$1000 Deposit	\$90 Reserves	\$900 Deposit
\$900 Loans	D_1	\$810 Loans	$D_2 = 0.9D_1$

Bank C		Bank N		
Asset	Liabilities	..	Assets	Liabilities
\$81 Reserves	\$810 Deposit	..	\$0.1*D _N Reserves	0.9 ^N \$1000
\$729 Loans	$D_3 = 0.9D_2$..	\$0.9*D _N Loans	$D_N = 0.9^N D_1$

- 4) Derivation: total deposit in the banking system=A's deposit + B's deposit+...+ N's deposit.

$$\text{Total D} = M = D_1 + D_2 + D_3 + \dots + D_N = D_1(1 + 0.9 + 0.9^2 + \dots + 0.9^N) = D_1 / rr.$$
The formula for an infinite sum of geometric series $1 + x + x^2 + \dots = 1/(1 - x)$

- 5) Monetary base (high power money) is the sum of currency (including coin) in circulation outside Federal Reserve Banks and the U.S. Treasury, plus reserve deposits held by depository institutions at Federal Reserve Banks. ($MB=C+R$) <https://fred.stlouisfed.org/series/BASE>
- 6) Reserves are balances at the Fed of all depository institutions that are used to satisfy reserve requirements and balances held in excess of balance requirements. It excludes reserves held in the form of cash in bank vaults, and excludes service-related deposits. They are the most important component of the money stock, and the one most directly controlled by the Fed.
- 7) Money multiplier model: $M=m*MB$ and $m=(1+cr)/(rr+cr)$, where $M=C+D$ is total money supply, MB is the monetary base, $cr=C/D$ is the currency ratio and rr is the reserve ratio= R/D .
- 8) Derivation: substitute $M=C+D$ and $MB=C+R$ into $M=m*MB$ so that $m=M/MB=(C+D)/(C+R)=(C/D+D/D)/(C/D+R/D)=(cr+1)/(cr+rr)$. Money supply is negatively related to cr and rr .
- 9) Precisely, the banking system creates new credit/debt, which must be cleared in the future.
- 10) The Great Depression: from 1929 to 1933, more than 9,000 banks closed and the money supply fell 28%. This drop in the money supply may not have caused the Great Depression, but it certainly contributed to its severity.
- 11) The Great Recession: from 2008 to 2013, the Fed and QE1, 2, 3 (large scale asset purchase).



V. The Fed and Monetary Policy

1. Founded in 1913, the Federal Reserve System consists of Federal Reserve Board of Governors, 12 Regional Federal Reserve Banks, and the Federal Open Market Committee (FOMC).
2. Policy goals <https://www.chicagofed.org/research/dual-mandate/dual-mandate>
 - 1) Macroeconomic stability (Fed's dual mandate: price stability and full employment)
 - 2) Financial stability (avoid bank runs and financial panic via supervision and regulation)
3. The Fed's balance sheet
 - 1) Assets: U.S. Treasury securities, other securities, lending to depository institutions,
 - 2) Liabilities: currency, reserves, deposits held by depository institutions

<https://www.federalreserve.gov/monetarypolicy/quarterly-balance-sheet-developments-report.htm>

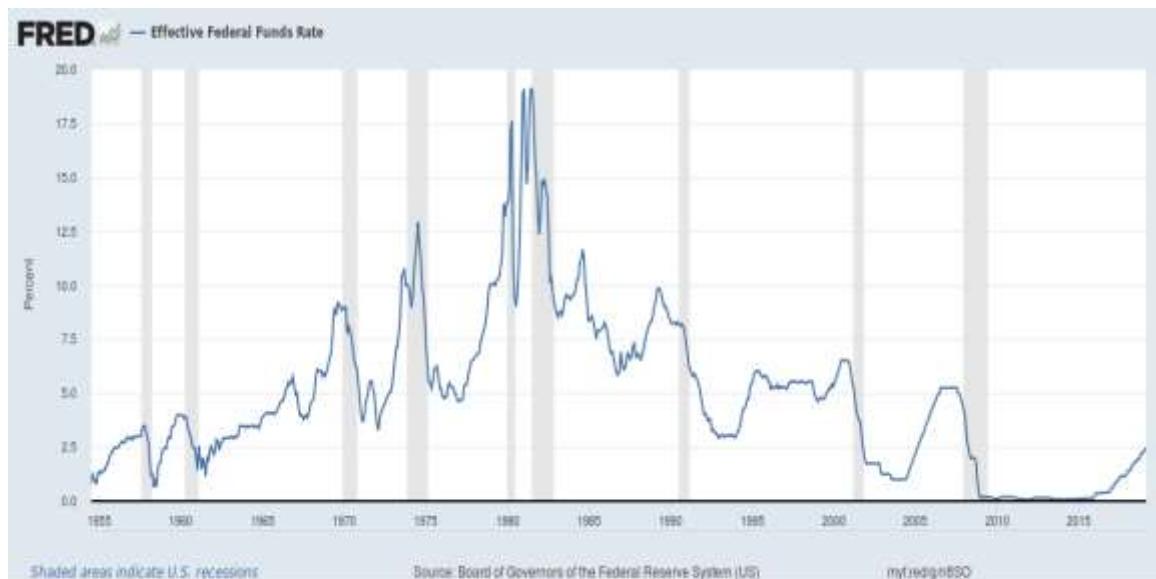


4. Conventional tools

- 1) Open market operation (OMOs): adjust the supply of reserve balances so as to keep the federal funds rate around the target federal funds rate established by the FOMC. Purchasing securities will result in an increase of money supply (MB) while selling them will cause a decrease.
- 2) Discount window lending: relieve liquidity strains for individual depository institutions and for the banking system as a whole by providing a source of funding in times of need.
- 3) Reserve requirements <https://www.federalreserve.gov/monetarypolicy/reservereq.htm>

5. The federal funds rate (FFR)

- 1) The federal funds rate is the interest rate at which depository institutions trade federal funds (balances held at Federal Reserve Banks) with each other overnight. When a depository institution has surplus balances in its reserve account, it lends to other banks in need of larger balances. In simpler terms, a bank with excess cash, which is often referred to as liquidity, will lend to another bank that needs to quickly raise liquidity.
- 2) The rate that the borrowing institution pays to the lending institution is determined between the two banks; the weighted average rate for all of these types of negotiations is called the effective federal funds rate. The effective federal funds rate is essentially determined by the market but is influenced by the Federal Reserve through open market operations to reach the federal funds rate target.
- 3) The federal funds rate is the central interest rate in the U.S. financial market. It influences other interest rates such as the prime rate, which is the rate banks charge their customers with higher credit ratings. Additionally, the federal funds rate indirectly influences longer-term interest rates such as mortgages, loans, and savings, all of which are very important to consumer wealth and confidence.
- 4) The Federal Open Market Committee (FOMC) meets eight times a year to determine the federal funds target rate. As previously stated, this rate influences the effective federal funds rate through open market operations or by buying and selling of government bonds (government debt).



- 5) More specifically, the Federal Reserve decreases liquidity by selling government bonds, thereby raising the federal funds rate because banks have less liquidity to trade with other banks. Similarly, the Federal Reserve can increase liquidity by buying government bonds, decreasing the federal funds rate because banks have excess liquidity for trade. Whether the Federal Reserve wants to buy or sell bonds depends on the state of the economy.
- 6) If the FOMC believes the economy is growing too fast and inflation pressures are inconsistent with the dual mandate of the Federal Reserve, the Committee may set a higher federal funds rate target to temper economic activity. In the opposing scenario, the FOMC may set a lower federal funds rate target to spur greater economic activity. Therefore, the FOMC must observe the current state of the economy to determine the best course of monetary policy that will maximize economic growth while adhering to the dual mandate set forth by Congress. In making its monetary policy decisions, the FOMC considers a wealth of economic data, such as: trends in prices and wages, employment, consumer spending and income, business investments, and foreign exchange markets. <https://fred.stlouisfed.org/series/FEDFUNDS>
6. Nonconventional tools (developed during and after the 2008 global financial crisis)
 - 1) Liquidity provision, discount window expansion, term auction facility, new lending programs
 - 2) Large scale asset purchases (LSAPs)
 - 3) Forward guidance (management of expectations OMO)
 - 4) Interest payments on bank reserves (IOER)
 - 5) Operation twist and yield curve control (OT & YCC)
7. Lender of last resort in financial crisis (Bagehot's Rule: Lend without limit, to solvent firms, against good collateral, at 'high rates'.) <http://www.levyinstitute.org/topics/bagehots-rule>

Readings

U.S. Monetary Data

<https://fred.stlouisfed.org/categories/24>

<https://www.federalreserve.gov/releases/h6/current/>

<https://www.federalreserve.gov/releases/h3/current/>

<https://fredblog.stlouisfed.org/2019/02/how-much-cash-is-out-there/>

Visualization on Money <http://money.visualcapitalist.com>

The History of Money <https://www.pbs.org/wgbh/nova/article/history-money/>

Buying Power of the U.S. Dollar Over the Last Century

<https://www.visualcapitalist.com/buying-power-us-dollar-century/>

Monetary Policy Basics

<https://www.federalreserveeducation.org/about-the-fed/structure-and-functions/monetary-policy>

Federal Reserve System by Richard H. Timberlake

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Monetarism by Bennett T. McCallum

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Bank Runs by George G. Kaufman

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<https://www.federalreserve.gov/monetarypolicy.htm>

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Bagehot for Beginners: The Making of Lender of Last Resort Operations in the Mid-Nineteenth Century

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Lecture 10 Business Cycle Theory

Biwei Chen (Updated: April 11)

Reference: Mankiw, 2019, CH10 Introduction to Economic Fluctuations

Topics: 1. Business Cycle Fluctuations; 2. Aggregate Demand Aggregate Supply Model; 3. The U.S. Stagflation in the late 1970s; 4. Macroeconomic Stabilization Policy

Notation: While Y is the real income or output in the textbook, it is also used to denote nominal income P^*Q in several places (CH2 & 3).

Economies exhibit short-run fluctuations in output and other variables, known as the business cycle. When the economy is doing well, so that output and employment are rising, it is said to be expanding. If output and employment start to fall, the economy is said to be contracting (or in recession). The turning point from expansion to contraction is known as the peak of the business cycle, while the turning point from contraction to expansion is called the trough.

I. The NBER's Business Cycle Dating Procedure

1. The National Bureau of Economic Research's Business Cycle Dating Committee maintains a chronology of the U.S. business cycle. The chronology comprises alternating dates of peaks and troughs in economic activity.
2. The NBER does not define a recession in terms of two consecutive quarters of decline in real GDP. Rather, a recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales.
3. A recession is a period between a peak and a trough, and an expansion is a period between a trough and a peak. During a recession, a significant decline in economic activity spreads across the economy and can last from a few months to more than a year.
4. Similarly, during an expansion, economic activity rises substantially, spreads across the economy, and usually lasts for several years.

<https://www.nber.org/cycles.html>

<https://www.nber.org/cycles/recessions.html>

https://www.nber.org/cycles/recessions_faq.html

II. Business Cycle Fluctuations: Facts and Patterns

1. GDP growth averages 3 – 3.5% per year over the long run, with large fluctuations in the short run. Unemployment rises during recessions and falls during expansions.
2. Consumption and investment fluctuate with business cycles, but consumption tends to be less volatile and investment more volatile than GDP.
3. Government expenditure tends to rise in the recessions and fall afterwards (countercyclical).
4. Inflation rate and interest rate are moving together and pro-cyclical.
5. Starting in the mid-1980s, the U.S. economy experiences a reduction in volatility of business cycle fluctuations.

Figure 1: U.S. real GDP growth rate and civilian unemployment rate, 1949-2019

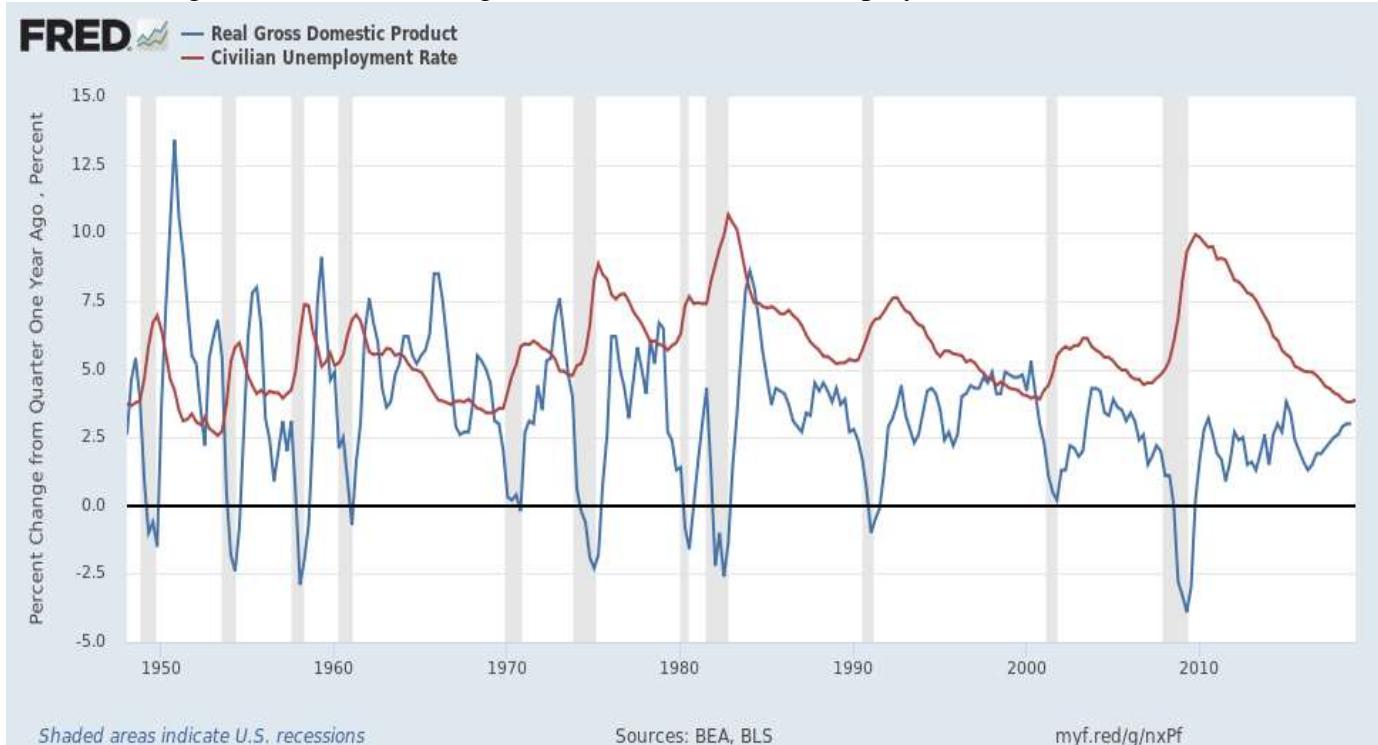


Figure 2: U.S. aggregate demand components (annual growth rates), 1949-2018

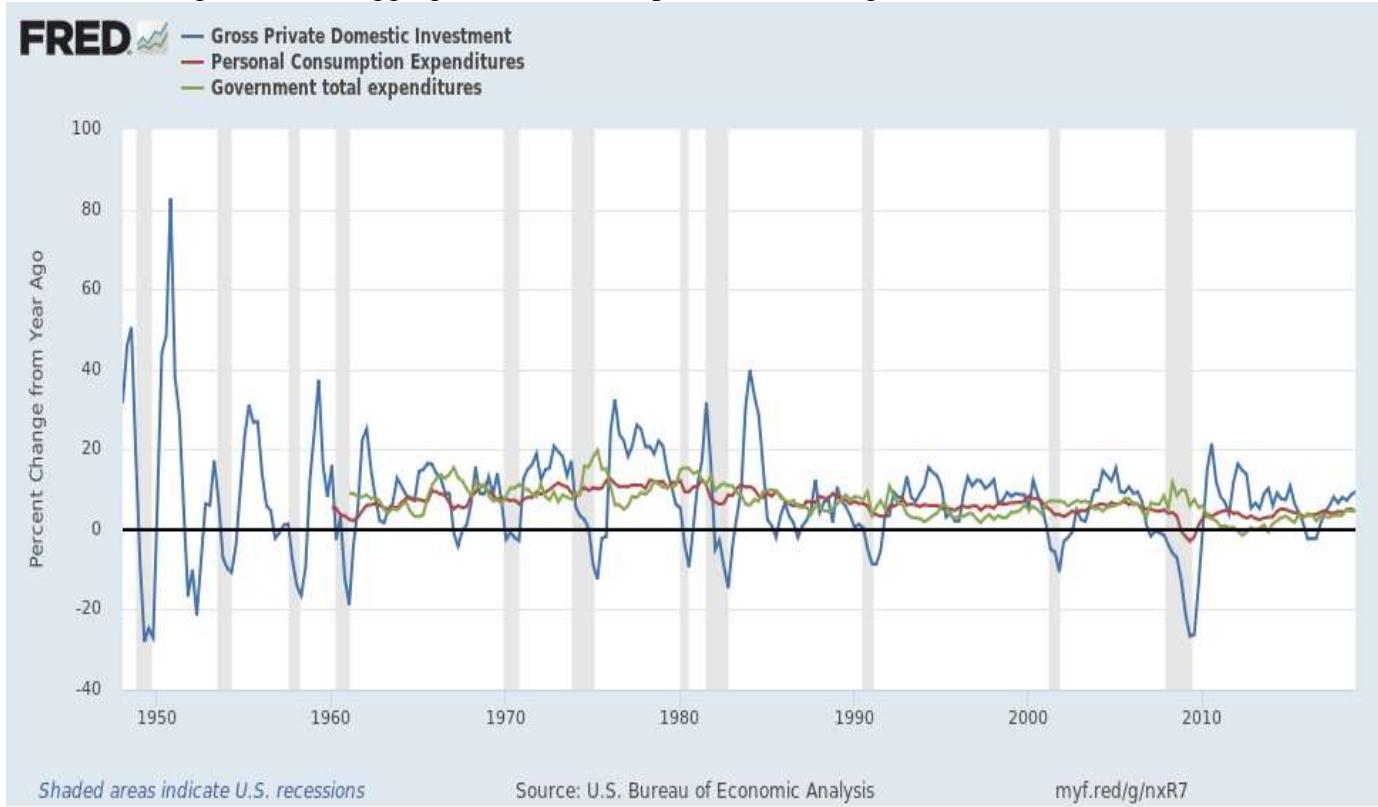
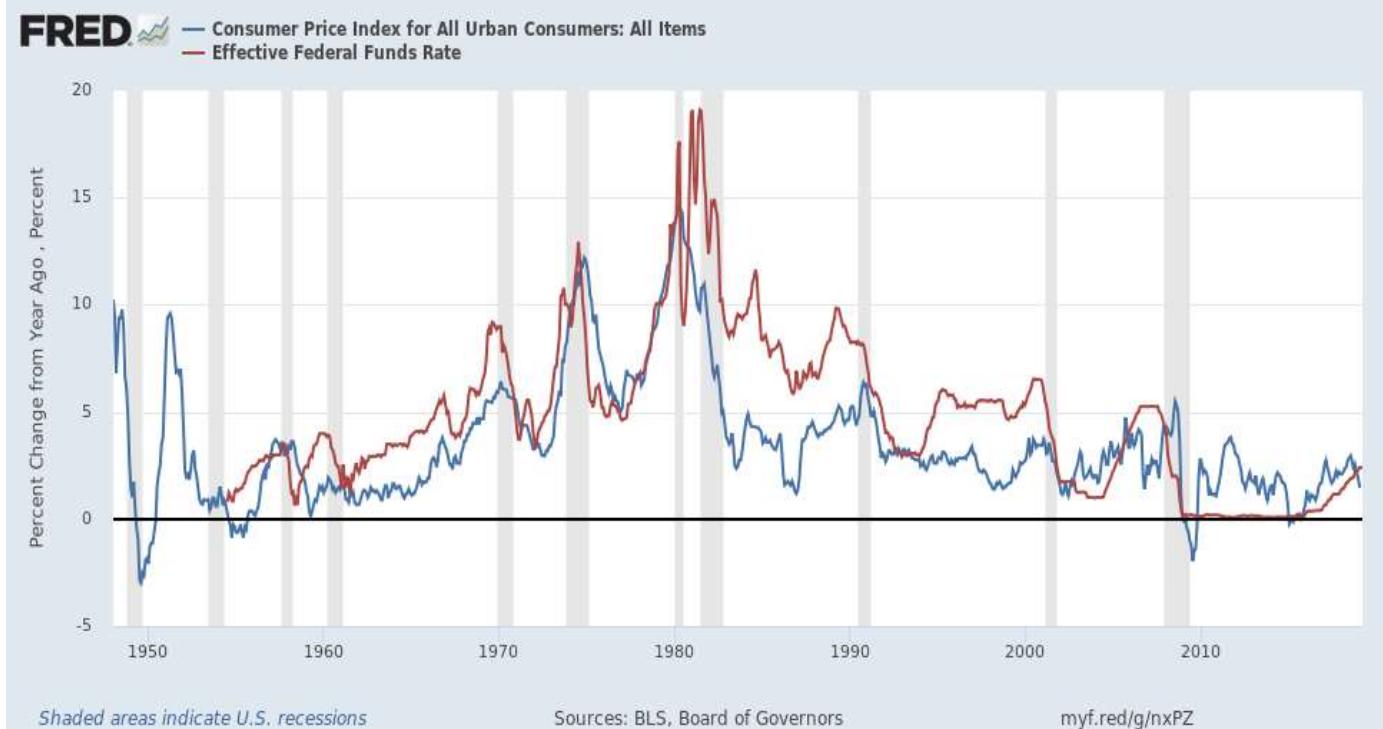
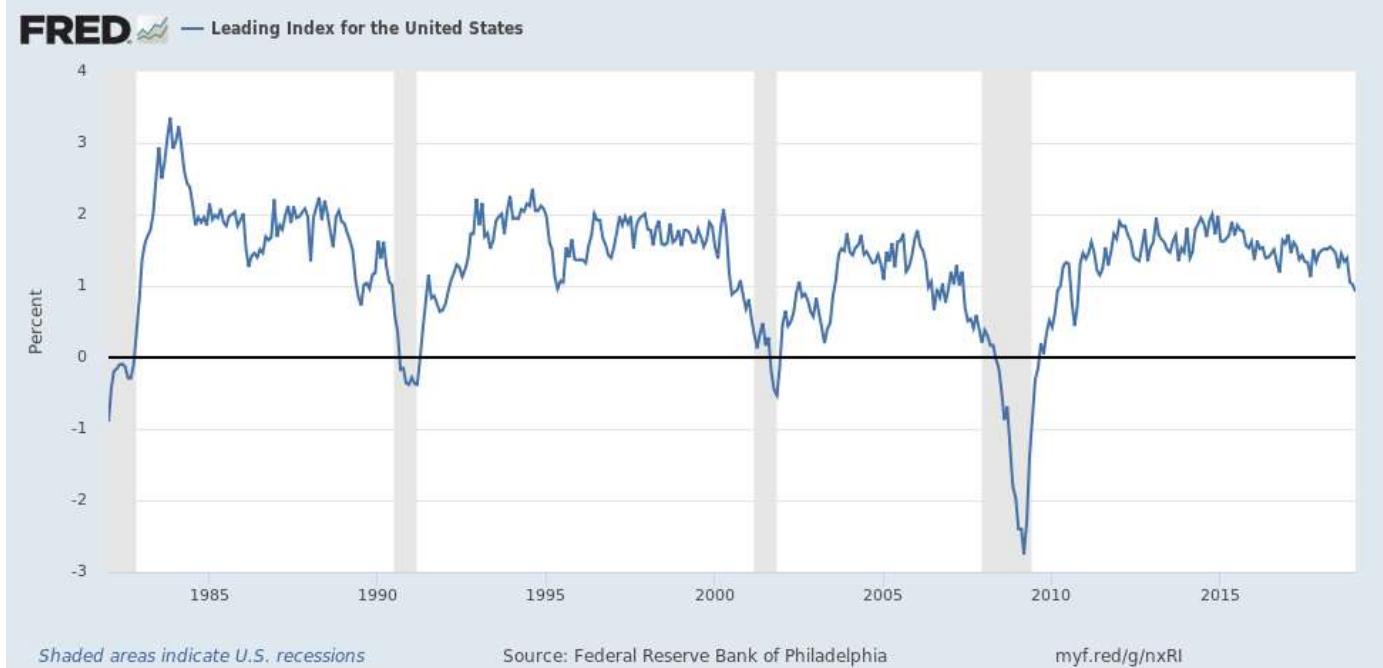


Figure 3: U.S. CPI inflation rate and effective federal funds rate, 1949-2019



6. The leading index for each state predicts the six-month growth rate of the state's coincident index. The index turns downward a few months to a year before almost every recession. It also turns upward just prior to the end of almost every recession. <https://fred.stlouisfed.org/series/USSLIND>

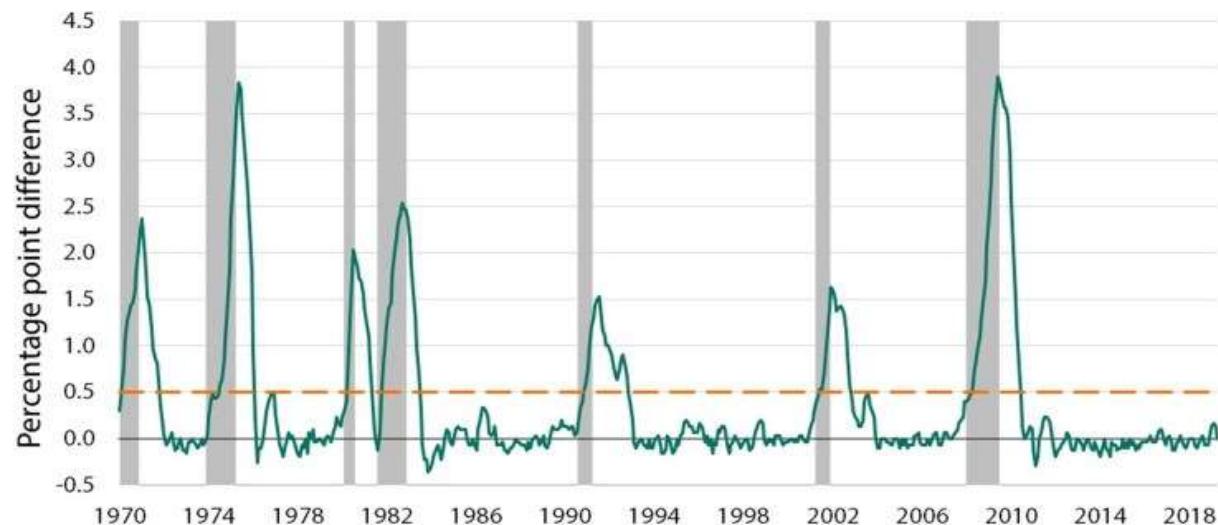


7. Financial indicators <https://fred.stlouisfed.org/categories/46>

8. NBER recession announcements are appropriate for historical analysis but are too slow to be useful for policy. (The NBER announced the Great Recession in December 2008, a full year after the recession had already started—far too late to initiate a timely monetary or fiscal policy response.)
9. Unemployment rate as a recession indicator: In fact, as economist Claudia Sahm writes in a new Hamilton Project at Brookings and Washington Center for Equitable Growth book, if the unemployment rate (in the form of its three-month average) is at least 0.50 percentage points above its minimum from the previous 12 months, then the economy is already in a recession. (The use of the three-month moving average of the unemployment rate smooths out small jumps or dips that can be particularly misleading when using real-time data that policymakers have in the moment.) Sahm proposes using this indicator to trigger stimulus payments to individuals when the economy is in a recession. This approach is appropriate because, as the book discusses in detail and figure 1 below shows, the indicator has both correctly signaled a recession 4–5 months following the beginning of the recession and has virtually never called a recession incorrectly since 1970.

FIGURE 1

The Sahm Recessions Indicator: Unemployment Rate (3-Month Average) Relative to Prior 12-Month Low, 1970–2019



Source: Current Population Survey, Bureau of Labor Statistics 1969–2019; Sahm 2019.
Note: Shaded areas denote recessions. Dashed orange line denotes the proposed recession indicator threshold of 0.50. Calculation uses real-time estimates of the unemployment rate.

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III. The AD-AS Model

1. Assumptions on the time horizon

- 1) Short-run price stickiness (AD fluctuates)
- 2) Long-run price flexibility (AS and AD change)

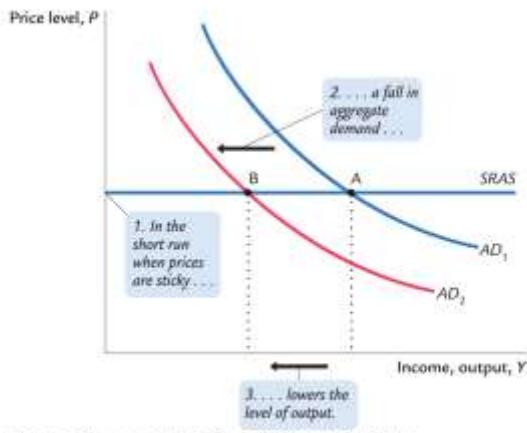
Model	Assumptions	Time Frame
Short run	Sticky prices, possible unemployment of labor and capital	Month-to-month or year-to-year
Long run	Flexible prices, full employment of labor and capital; constant capital, labor force, and technology	Several years
Very long run	Flexible prices, full employment of labor and capital; variable capital, labor force, and technology	Several decades

Source: Mankiw (2019)

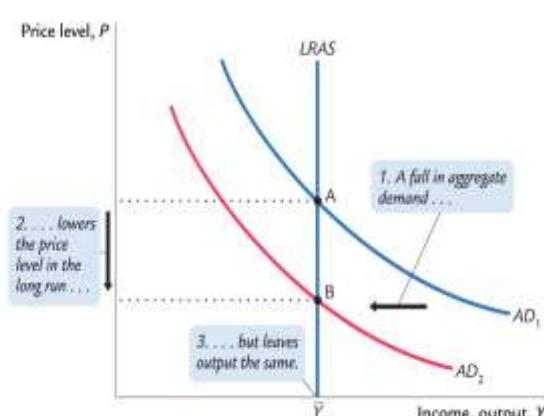
2. The economy can be described by short-run and long-run equilibrium

The AD-AS model is the paradigm most mainstream economists and policymakers use to think about economic fluctuations and policies to stabilize the economy. It shows how the price level and aggregate output are determined and how the economy's behavior is different in the short run and in the long run.

- 1) In the short run, assuming all prices are stuck at the predetermined level, firms are willing to sell as much as customers are willing to buy. Hence, the short-run aggregate supply curve SRAS is horizontal and equilibrium output is determined by aggregate demand.
- 2) In the long run, output is determined by production factors and technology. Y_L is the full-employment or natural level of output, at which the economy's resources are fully employed. Therefore, in the model, the long-run aggregate supply curve LRAS is vertical.



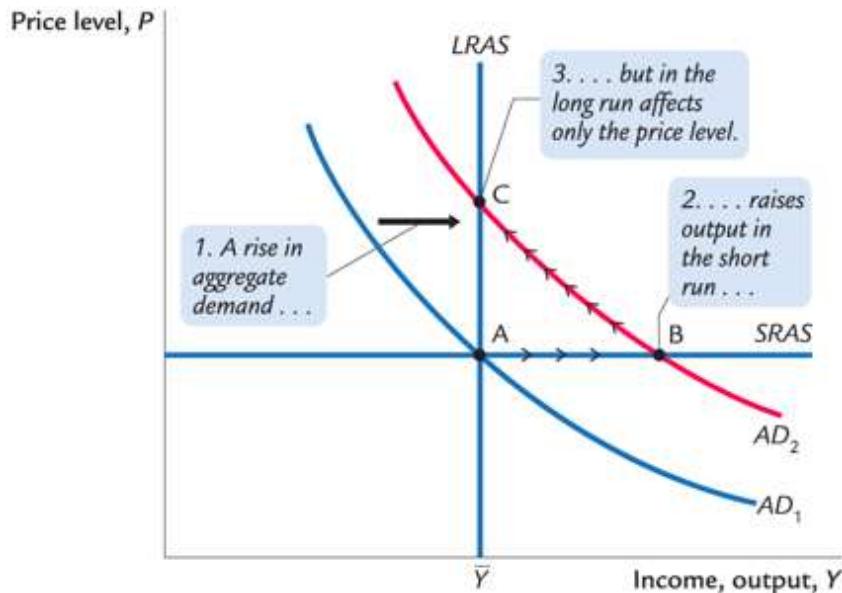
Mankiw, Macroeconomics, 10e, © 2019 Worth Publishers



Mankiw, Macroeconomics, 10e, © 2019 Worth Publishers

- 3) Long-run equilibrium: the economy finds itself at the intersection of the LRAS and AD. Because prices have adjusted to reach this equilibrium, the SRAS crosses this point as well.
- 4) AD-AS model: Aggregate Demand: $Y=C(Y-T)+I(r)+G$; Short-run AS: $Y=Y_L+a(P-P^E)$; Long-run AS: $Y_L=F(K, L)$; Money market: $M/P=L(i, Y)$; Interest rate and inflation rate: $i=r+\pi^e$

3. Short-run to long-run adjustment

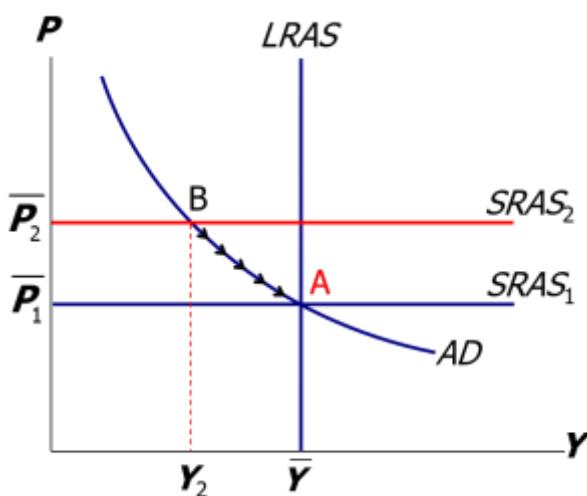


- 1) In the long-run equilibrium, the economy starts at point A where $SRAS=LRAS=AD$; output and unemployment are at their natural rates (long-run trend).
- 2) Suppose the Fed increases the money supply and banks extend their credit, shifting AD to the right. In the short run, prices are sticky, so output rises. The new short-run equilibrium is at point B, where output is above its natural level. The economy is in expansion.
- 3) In order for firms to increase output, they hire more workers, so unemployment falls below the natural rate of unemployment, putting upward pressure on wages. The high level of demand for goods and services at point B puts upward pressure on prices.
- 4) Over time, as prices become adjustable, they begin to rise in response to these pressures. The price level rises, and the economy moves up along the AD_2 curve, from point B toward point C.
- 5) This process stops when the economy gets to point C: output again equals the natural rate of output, and unemployment again equals the natural rate of unemployment, so there is no further pressure on prices to change. It is accompanied by an upward movement of SRAS.

3. The OPEC oil shocks and stagflation

The 1973 oil crisis began in October 1973 when the members of the Organization of Arab Petroleum Exporting Countries proclaimed an oil embargo. The embargo was targeted at nations perceived as supporting Israel during the Yom Kippur War. The initial nations targeted were Canada, Japan, the Netherlands, the United Kingdom and the United States with the embargo also later extended to Portugal, Rhodesia and South Africa. By the end of the embargo in March 1974, the price of oil had risen from US\$3 per barrel to nearly \$12 globally; US prices were significantly higher. The embargo caused an oil crisis, or "shock", with many short- and long-term effects on global politics and the global economy. It was later called the "first oil shock", followed by the 1979 oil crisis, termed the "second oil shock."

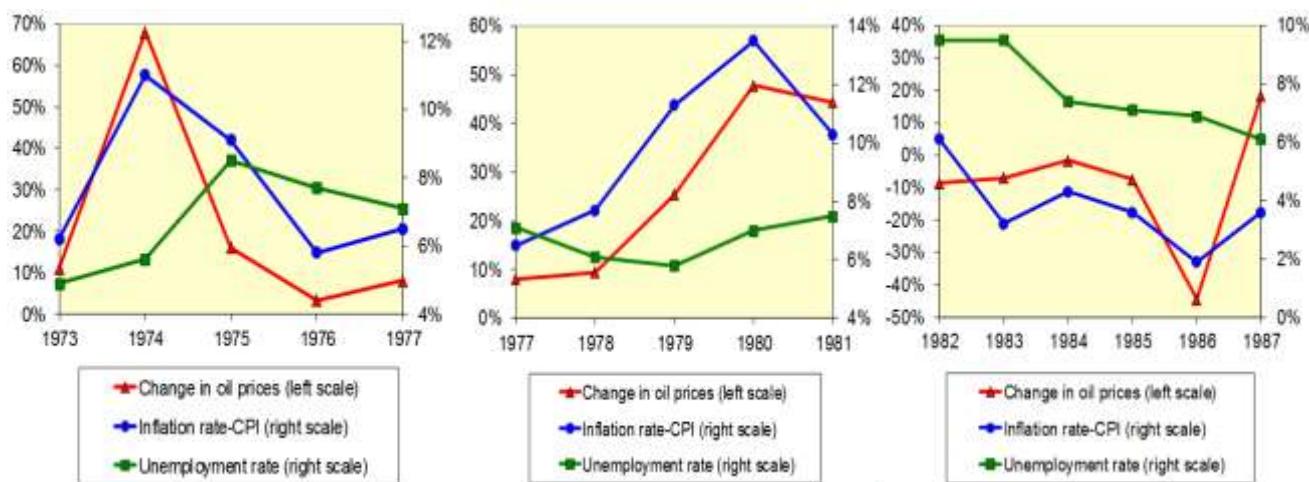
- 1) Early 1970s: OPEC coordinated a reduction in the supply of oil. Oil prices rose 11% in 1973, 68% in 1974, 16% in 1975. Such sharp oil price increases are supply shocks because they significantly impact production costs and prices.
- 2) The 1970s oil shock: Oil is required to heat the factories in which goods are produced and to fuel the trucks that transport the goods from the factories to the warehouses to Walmart stores. A sharp increase in the price of oil, therefore, has a substantial effect on production costs.



- a. The oil price shock shifts up SRAS, causing output and employment to fall.
- b. In the absence of further price shocks, prices will fall over time, and economy moves back toward full employment.
- c. As output falls from \bar{Y} to \bar{Y}_2 in the graph, we would expect to see unemployment increase above the natural rate of unemployment.
- d. Note the phrase “in the absence of further price shocks.” As we will see shortly, just as the economy was recovering from the first big oil shock, a second one came along.

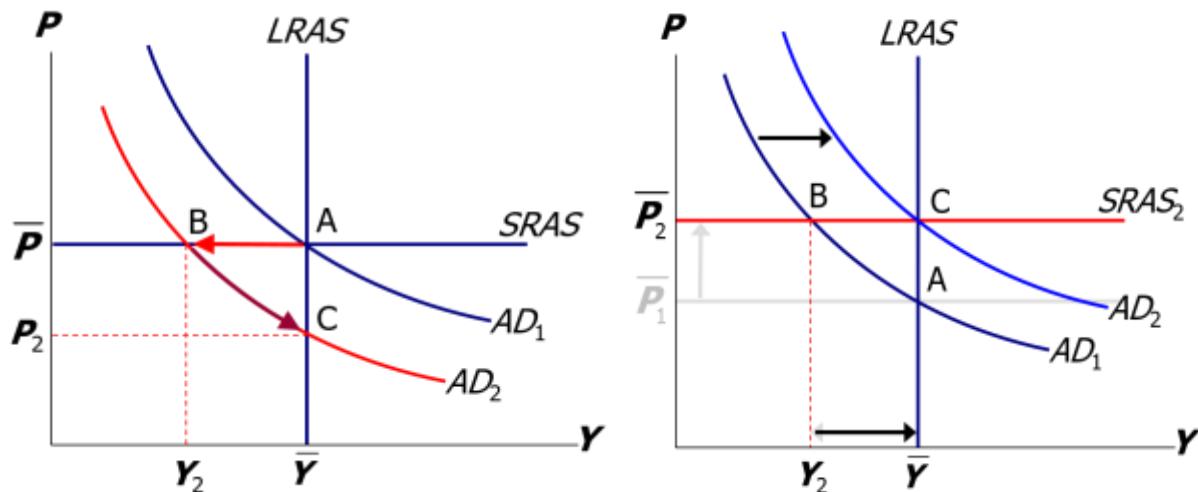
3) Macroeconomic variations 1973-1987

Predicted effects of the oil shock: inflation, output, unemployment...and then a gradual recovery. Late 1970s: This second shock was associated with the revolution in Iran. As the economy was recovering, oil prices shot up again, causing another huge supply shock! 1980s: A favorable supply shock—a significant fall in oil prices. Oil prices fell about 10% in 1982 and generally fell during most years between 1982 and 1986. As the model predicts, inflation and unemployment fell.

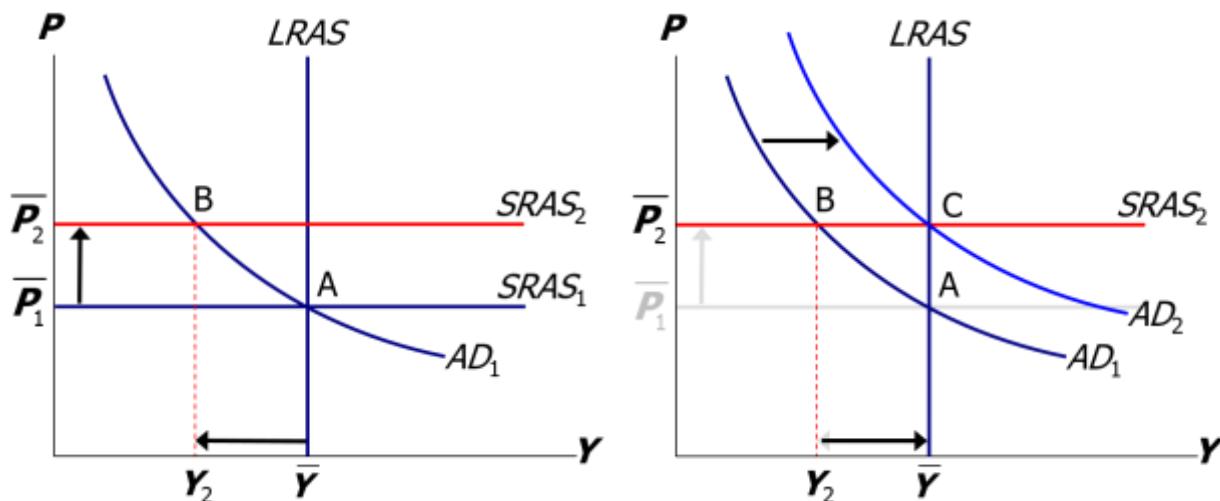


4. Macroeconomic stabilization policy

- 1) Aggregate demand and supply shocks: exogenous changes in aggregate supply or demand (endogenous variables are P and Q). A supply shock alters production costs, affects the prices that firms charge (also called price shocks). Shocks can temporarily push the economy away from full employment and output.
- 2) Examples of negative demand shocks: A stock market crash causes consumers to cut back on spending; A fall in business confidence causes a decrease in investment; A recession in a country with which we trade causes an exogenous decrease in their demand for our exports.
- 3) Examples of adverse supply shocks: Bad weather reduces crop yields, pushing up food prices; Workers unionize, negotiate wage increases; New environmental regulations require firms to reduce emissions. Firms charge higher prices to help cover the costs of compliance. Favorable supply shocks lower costs and prices.
- 4) Stabilization policy: policy actions aimed at reducing the severity of short-run economic fluctuations. Example: using monetary policy to combat the effects of adverse supply shocks
- 5) Stabilizing the demand shock: the adverse demand shock moves the economy to point B. But the Fed accommodates the shock by raising aggregate demand back to (C). Results: P stays the same and Y remains at its full-employment level.



- 6) Stabilizing the supply shock: the adverse supply shock moves the economy to point B. But the Fed accommodates the shock by raising aggregate demand (C). Results: P is permanently higher, but Y remains at its full-employment level. If the Fed correctly anticipates the sign and magnitude of the shock, then the Fed can respond as the shock occurs rather than after, and the economy would never go to point B—but would go immediately to point C.



IV. The Great Depression

1. Severity economic indicators

- 1) Nominal GNP fell 46% from 1929 to 1933
- 2) Real GNP fell 33% from 1929 to 1933
- 3) Price level declined 25% from 1929 to 1933
- 4) Unemployment rate went from 4% in 1929 to 25% in 1933
- 5) Real GNP did not recover to its 1929 level until 1937
- 6) The unemployment rate did not fall below 10% until WWII
- 7) Bank panics and failures: 9,000 failed between 1930 and 1933

2. Theoretical causes and the role of monetary policy

- 1) Liquidationist theory: overproduction and excessive borrowing cause resource misallocation, and that depressions are the inevitable and necessary means of correction
- 2) Monetarist theory: Federal Reserve System failed to prevent banking panics and money supply contraction
- 3) Keynesian theory: declines in business investment or household consumption had reduced aggregate demand, which had caused the decline in economic activity

3. Debates on monetary policy and conditions: easy or tight?

Easy: low interest rates and an apparent lack of demand for reserves

Exceptionally low yields on short-term securities has suggested an abundance of liquidity

Relative few banks came to the Fed's discount window to borrow reserves

Tight: falling money stock, price deflation, and rising real interest rate

While the nominal yield on short-term government securities fell to an exceptionally low level, deflation implied that their real yield rose above 10 percent in 1930 and 1931

4. The Gold Standard International Monetary System

V. Real Business Cycle Theory (RBC)

Readings

US Business Cycle Expansions and Contractions <http://www.nber.org/cycles/cyclesmain.html>
https://www.nber.org/cycles/US_Business_Cycle_Expansions_and_Contractions_20120423.pdf

Business Cycles by Christina D. Romer
<https://www.econlib.org/library/Enc/BusinessCycles.html>

2019 Why Are Recessions So Hard to Predict? Random Shocks and Business Cycles
<https://www.philadelphiahfed.org/-/media/research-and-data/publications/economic-insights/2019/q1/eiq119-predicting-recessions.pdf?la=en>

Ray Dalio 2018, Video: How the Economic Machine Works?
<https://www.youtube.com/watch?v=PHe0bXAIuk0>

Ray Dalio 2018, Principles for Navigating Big Debt Crisis. The Archetypal Big Debt Cycle, pp.1-65.

Robert Shiller On Human Behavior - What Will Cause the Next Recession?
<https://www.youtube.com/watch?v=rUYk2DA8PH8&t=103s>

*20190606 How will we know when a recession is coming?
<https://www.brookings.edu/blog/up-front/2019/06/06/how-will-we-know-when-a-recession-is-coming/>

2019 Do Longer Expansions Lead to More Severe Recessions?
<https://www.clevelandfed.org/en/newsroom-and-events/publications/economic-commentary/2019-economic-commentaries/ec-201902-do-longer-expansions-lead-to-more-severe-recessions.aspx>

Emi Nakamura, Clark Medalist 2019 (price rigidity and adjustment)
<https://www.aeaweb.org/about-aea/honors-awards/bates-clark/emi-nakamura>

Emi Nakamura and Jón Steinsson. 2013. Price Rigidity: Microeconomic Evidence and Macroeconomic Implications. Annual Review of Economics, 5, 133-163.
<https://eml.berkeley.edu/~enakamura/papers/psurvey.pdf>

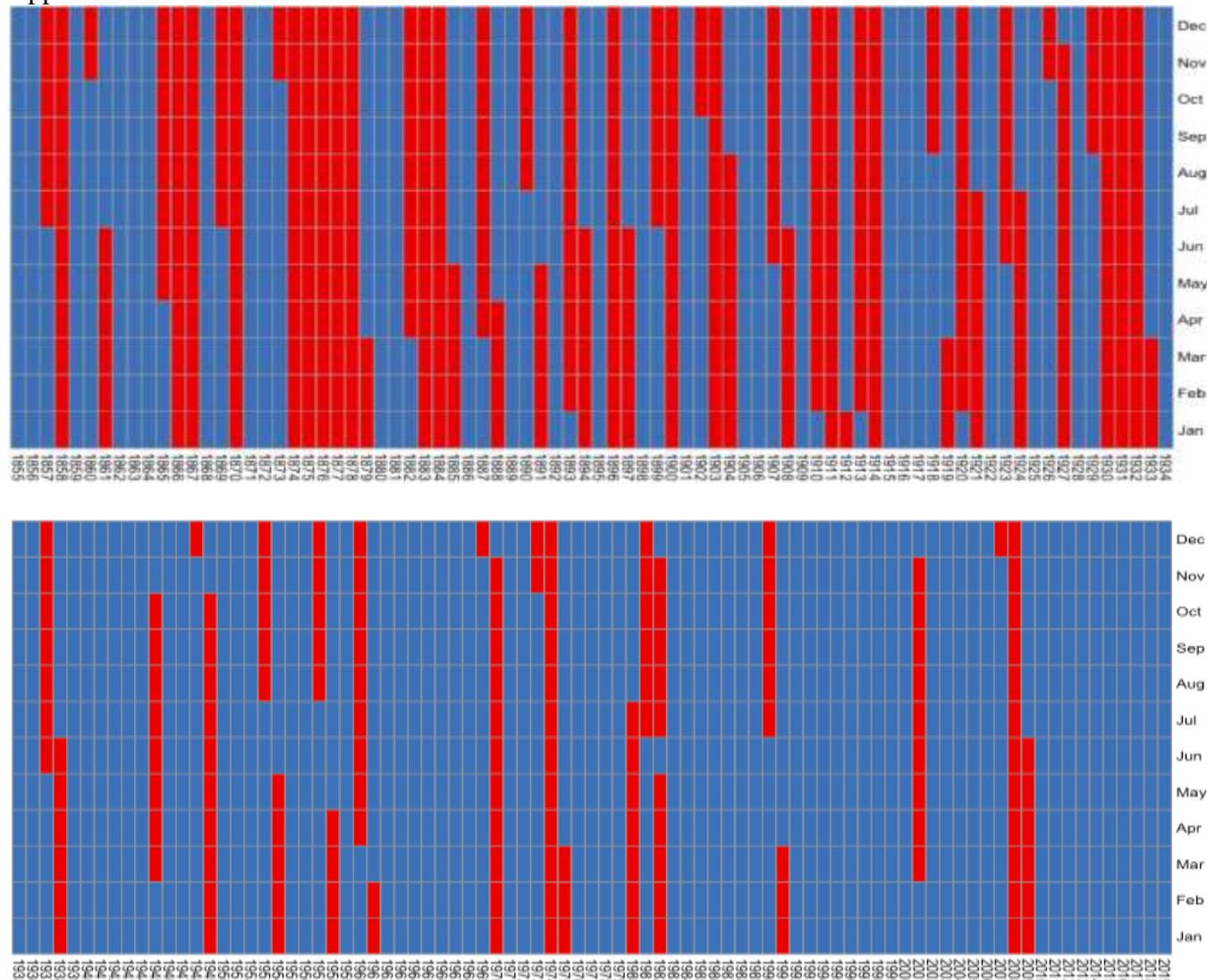
2008 Recession Dating and Real-Time Data
<https://www.philadelphiahfed.org/-/media/research-and-data/publications/research-rap/2008/recession-dating-and-real-time-data.pdf?la=en>

Mapping the World's Financial Weak Spots
<https://blogs.imf.org/2019/06/20/mapping-the-worlds-financial-weak-spots/>

Carlos Hamilton Araujo, Seppo Honkapohja, and James Bullard, "Panel Discussion: The Role of Potential Output in Policymaking," Federal Reserve Bank of St. Louis Review, July/August 2009, pp. 383-395. <https://doi.org/10.20955/r.91.383-395>

Neville Francis, Michael T. Owyang, and Daniel Soques, "Does the United States Lead Foreign Business Cycles?," Federal Reserve Bank of St. Louis Review, Second Quarter 2015, pp. 133-58. <https://doi.org/10.20955/r.97.133-58>

Appendix: NBER dated U.S. recessions 1855-2019



Source: Biwei Chen (2019)

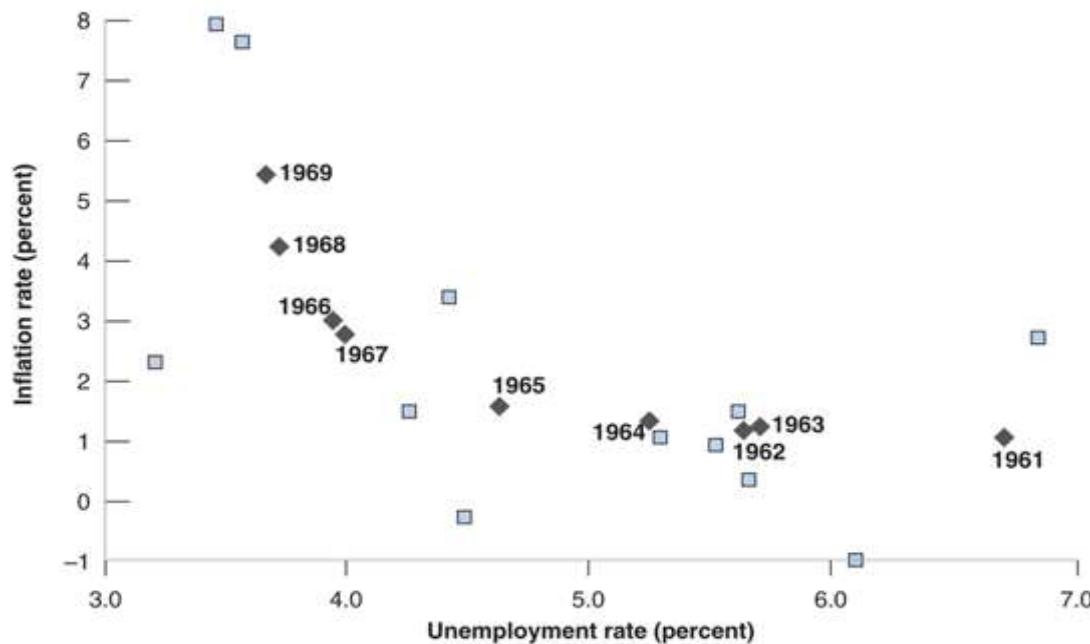
Lecture 11 Phillips Curve and Aggregate Supply

Biwei Chen (Updated: April 18)

Reference: Mankiw, 2019, CH14 Aggregate Supply and the Short-Run Tradeoff Between Inflation and Unemployment Topics: 1. Inflation and Unemployment; 2. The Short-Run and Long-Run Phillips Curve; 3. Aggregate Supply Curve.

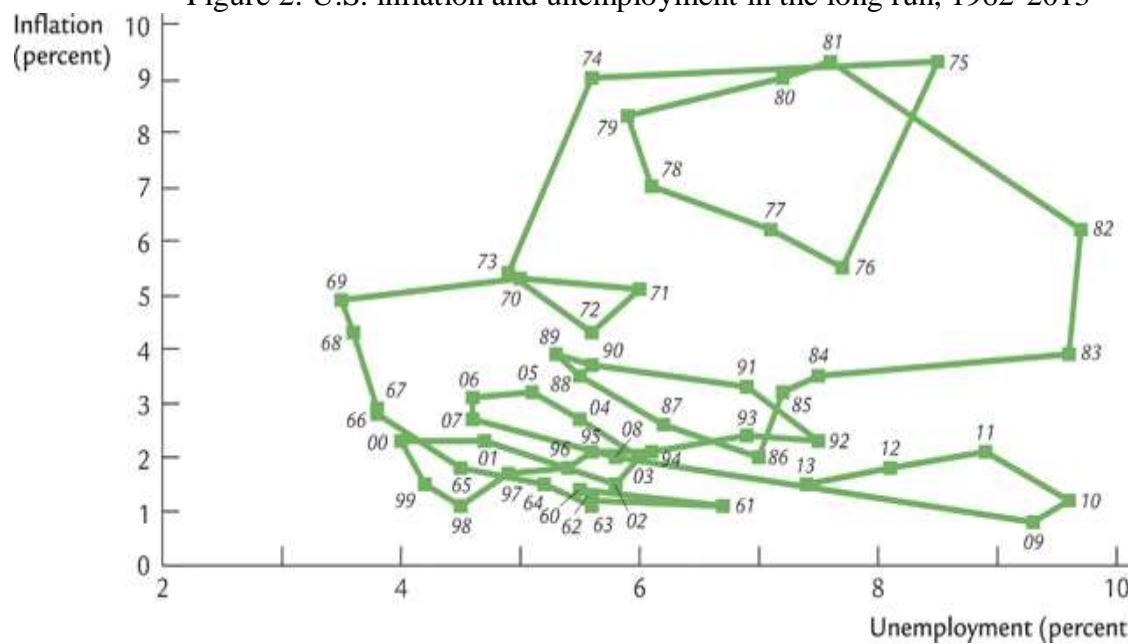
I. Inflation and unemployment relations

1. In 1958, A.W. Phillips showed that nominal wage growth was negatively correlated with unemployment in the U.K. In the 1960s, Paul Samuelson & Robert Solow found a negative correlation between U.S. inflation and unemployment, named it “the Phillips Curve.”
2. U.S. inflation (CPI) and unemployment 1948–1969

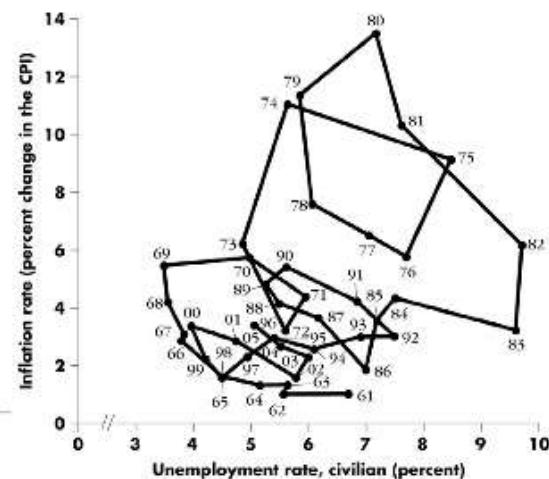
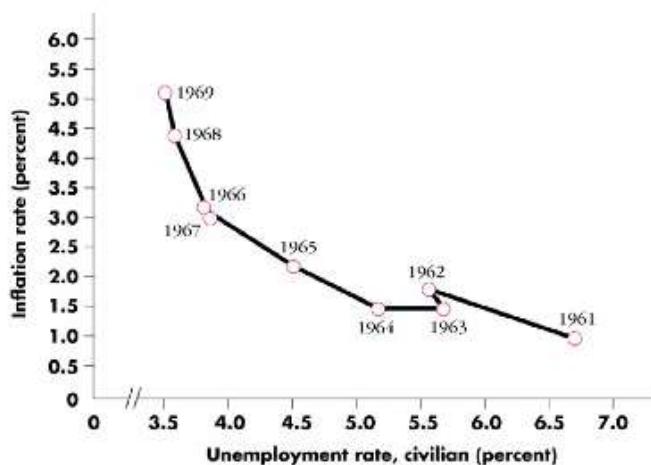


3. Phillips curve: the short-run trade-off between inflation and unemployment
4. More evidence: can we observe the Phillips curve in the long run?
 - 1) The 1970s: unemployment increased, despite higher inflation
 - 2) 1979-1987: the Volcker disinflation and rising unemployment
 - 3) 1986-2006: inflation and unemployment were low during most of Alan Greenspan's years
 - 4) 2006-2009: the financial crisis and sharply increasing unemployment and reducing inflation
 - 5) 2010-2012: a slow recovery reduced unemployment and increased inflation
5. Macroeconomic policy implications and effectiveness: for a time, macroeconomic policy options were often discussed in terms of the difficult choice between low unemployment and high inflation. The experience of the 1970s, when oil price shocks had a big impact on the economy, led economists to pay more attention to supply shocks when analyzing the Phillips curve.

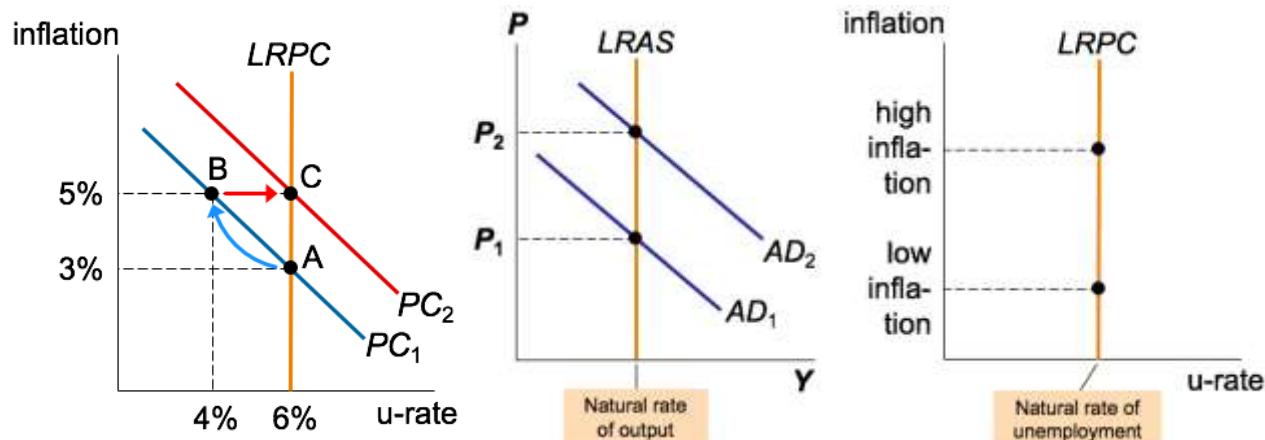
Figure 2: U.S. inflation and unemployment in the long run, 1962-2013



6. Macroeconomists' understanding of the Phillips curve was greatly increased in the 1960s, when Milton Friedman and Edmund Phelps emphasized that the nature of the Phillips curve relationship should change when expectations of inflation change. To bridge the gap between theory and evidence, Friedman and Phelps introduced a new variable: **expected inflation** – a measure of how much people expect the price level to change.



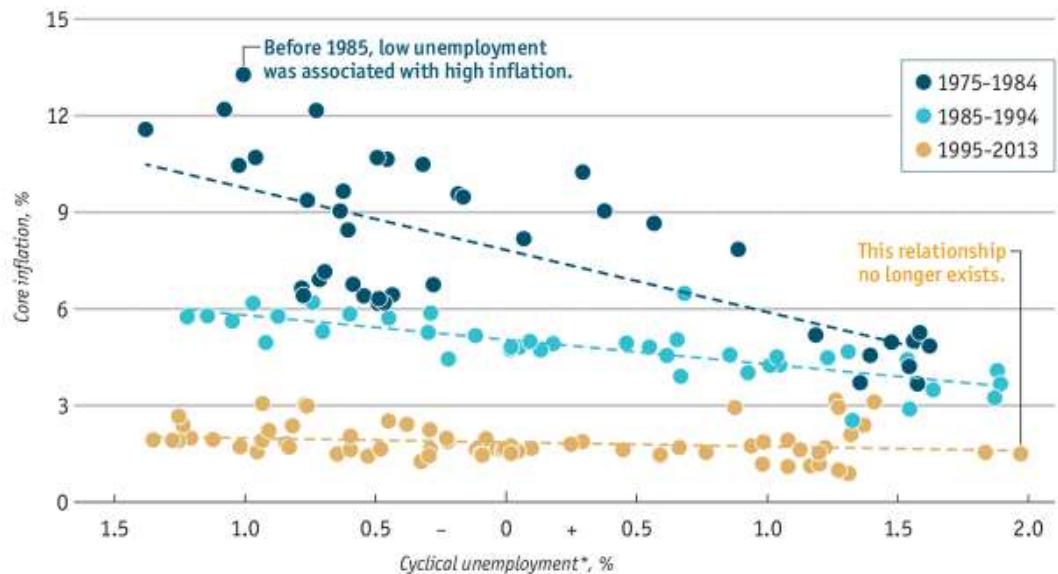
7. The idea that the long-run Phillips curve should be vertical was argued by Milton Friedman and Edmund Phelps. See in particular M. Friedman, "The Role of Monetary Policy," American Economic Review 58 (March 1968): 1–17.
8. Expected inflation rate and movement of the Phillips curve
- 1) Initially at point A, expected & actual inflation = 3%, unemployment = natural rate (6%).
 - 2) A to B, the Fed makes inflation 2% higher than expected, u-rate falls to 4%.
 - 3) In the long run, expected inflation increases to 5%, Phillips curve shifts upward, u-rate returns to its natural level.



9. In the AD-AS model, the greater the expansion of the money and credit, or the faster money velocity, will shift AD to the right, resulting in a larger increase in prices—i.e., higher inflation. But this higher inflation will not produce lower unemployment in the long run, unemployment always goes to its natural rate whether inflation is high or low. In the long run, faster money growth only causes faster inflation.
10. Recent evidence: flatten short-run Phillips curve

Flatlining

Inflation and cyclical unemployment, average across advanced economies, quarterly



Sources: OECD; IMF
Economist.com

*Actual unemployment minus the "natural" rate of unemployment

The Phillips curve may be broken for good

<https://www.economist.com/graphic-detail/2017/11/01/the-phillips-curve-may-be-broken-for-good>

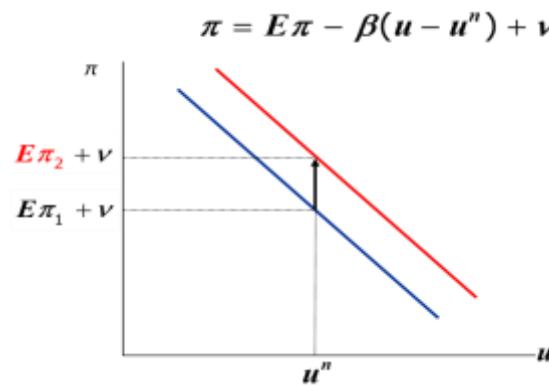
II. The Phillips Curve Models

1. Adaptive expectations

- 1) Assumption: people form their expectations of inflation based on recently observed inflation
- 2) Model: $\pi = \pi_{-1} - \beta(u - u^n) + v$, where π_{-1} is last year's inflation rate, β is a positive parameter, u is the unemployment rate, u^n is the natural rate of unemployment, and v is the inflation shock.
- 3) Current inflation is determined by past inflation, cyclical unemployment rate, and a shock.
- 4) Inflation inertia π_{-1} : higher inflation last year will lead to higher inflation this year, indicating a vertical upward shift of the short-run Phillips curve. Vice versa.
- 5) Cyclical unemployment ($u - u^n$), the deviation of unemployment from its natural rate, exerts upward or downward pressure on inflation. Low unemployment, relative to the natural rate, pulls the inflation rate up. High unemployment pulls the inflation rate down. The parameter β measures how responsive inflation can be to cyclical unemployment.
- 6) v is an unpredictable shock that can either be positive or negative, driving inflation up and down.
- 7) If π_{-1} is zero, then $\pi = a - \beta u$ and $a = \beta u^n$; if π_{-1} is not zero, the Phillips curve will shift around. Moreover, the adaptive P.C. is not stable because the change of inflation is self-enforcing.
- 8) Graph: in the $\pi-u$ coordinate system, the short-run Phillips curve is a downward sloping line with an intercept $\beta u + \pi_{-1}$, a slope of $-\beta$, cross the vertical line $u=u^n$ at π_{-1}

2. Rational expectations

- 1) Assumption: People base their expectations on all available information, including information about current and prospective future policies.
- 2) Model: $\pi = E\pi - \beta(u - u^n) + v$, where $E\pi$ is the expected future inflation.
- 3) Policy implication I: in the short-run, inflation and unemployment are negatively related. At any point in time, a policy maker who controls aggregate demand can choose a combination of inflation and unemployment on this short-run P.C.
- 4) Policy implication II: the short-run tradeoff between π and u depends on expected inflation. An increase in $E\pi$ shifts the short-run Phillips curve upward. People adjust their expectations over time, so the tradeoff only holds in the short run.
- 5) Policy implication III: to avoid accelerating inflation over time, the unemployment must be high enough that the actual inflation matches the expected rate of inflation.
- 6) NAIRU or u^* : nonaccelerating inflation rate of unemployment (the u -rate for which the change in the rate of inflation is zero)

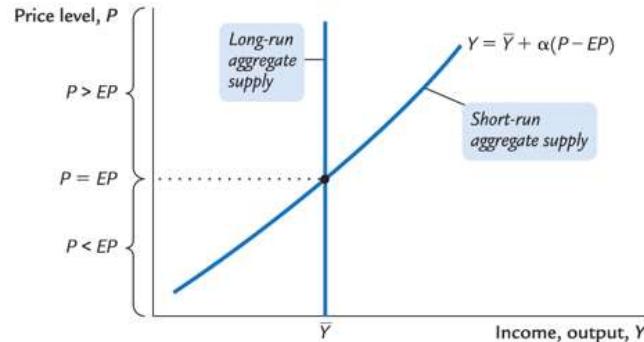


III. Aggregate Supply Model

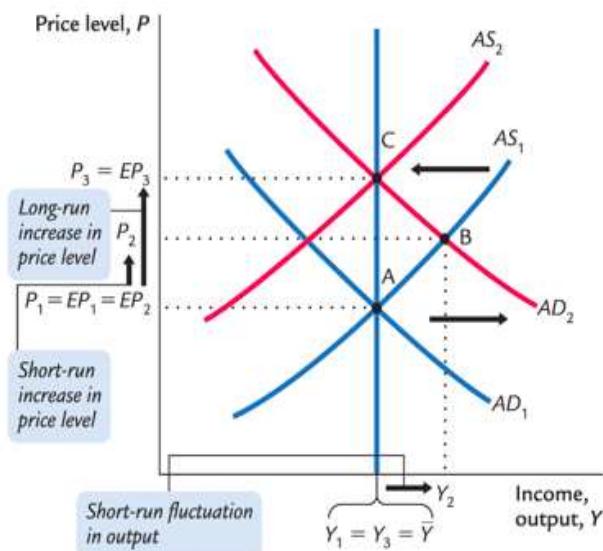
1. Short-run AS: $Y=P$
2. Long-run AS: $Y_L=F(K,L)$
3. Median-run AS: $Y=Y_L+a(P-EP)$

$$Y = \bar{Y} + \alpha(P - EP)$$

agg. output
natural rate of output
a positive parameter
expected price level
actual price level



4. Why the SRAS curve is bow-shaped? At low output levels, there are lots of unutilized and underutilized resources available, so it is not so costly for firms to increase output, and therefore firms do not require a big increase in prices to make them willing to increase output by a given amount. In contrast, at very high levels of output, when unemployment is below the natural rate and capital is being used at higher-than-normal intensity levels, it is relatively costly to increase output further. Hence, a larger increase in prices is required to make firms increase their output.
5. Imperfect-information and price-misperception: The supply of each good depends on its relative price: the nominal price of the good divided by the overall price level. The supplier doesn't know price level at the time she makes her production decision so uses EP . Suppose P rises but EP does not. Supplier thinks her relative price has risen, so she produces more. With many producers thinking this way, Y will rise whenever P rises above EP .
6. The AD-AS model: revisit



Aggregate demand shock and the economy adjustment from A to B then to C.

- 1) Start at \bar{Y} and P_1 , there is a positive AD shift, which shifts AD_1 to AD_2 .
- 2) The shift then results in a new short-run equilibrium at Y_2 and P_2 , the intersection of AD_2 and $SRAS_1$.
- 3) The price level adjustment shifts $SRAS_1$ back to $SRAS_2$. The new long-run equilibrium is at \bar{Y} and P_3 . Here LRAS, $SRAS_2$, and AD_2 all intersect.

Changes in the expected price level shift the SRAS curve. The adjustment of the economy back to full-employment output.

IV. Aggregate Supply and the Phillips Curve

1. SRAS curve: Output is related to unexpected movements in the price level. $Y=Y_L+a(P-P^E)$
2. Phillips curve: Unemployment is related to unexpected movements in the inflation rate.

$$\text{SRAS : } Y = \bar{Y} + \alpha(P - EP) \quad \text{Phillips curve : } \pi = E\pi - \beta(u - u^n) + v$$
3. Derivation for the Phillips curve

$$(1) Y = \bar{Y} + \alpha(P - EP)$$

$$(2) P = EP + (1/\alpha)(Y - \bar{Y})$$

$$(3) P = EP + (1/\alpha)(Y - \bar{Y}) + v$$

$$(4) (P - P_{-1}) = (EP - P_{-1}) + (1/\alpha)(Y - \bar{Y}) + v$$

$$(5) \pi = E\pi + (1/\alpha)(Y - \bar{Y}) + v$$

$$(6) (1/\alpha)(Y - \bar{Y}) = -\beta(u - u^n)$$

$$(7) \pi = E\pi - \beta(u - u^n) + v$$

(1) is the SRAS equation. Solve (1) for P to get (2).

To get (3), add the supply shock term to (2).

To get (4), subtract last year's price level (P_{-1}) from both sides.

To get (5), write π in place of $(P - P_{-1})$ and $E\pi$ in place of $(EP - P_{-1})$. Note that the change in the price level is not exactly the inflation rate, unless we interpret P as the natural log of the price level.

(6) captures the relationship between output and unemployment from Okun's law: the deviation of output from its natural rate is inversely related to cyclical unemployment.

Substitute (6) into (5) gives (7), the Phillips curve.

V. Policy Implications

1. The natural rate hypothesis

- 1) Changes in aggregate demand affect output and employment only in the short run. In the long run, the economy returns to the levels of output, employment, and unemployment described by the classical model.
- 2) Hysteresis: the long-lasting influence of history on variables such as the natural rate of unemployment. Negative shocks may increase unemployment, so the economy may not fully recover.
- 3) While workers are cyclically unemployed, their skills may deteriorate, and they may not find a job when the recession ends. Cyclically unemployed workers may lose their influence on wage setting; then, insiders (employed workers) may bargain for higher wages for themselves. Result: The cyclically unemployed "outsiders" may become structurally unemployed when the recession ends.

2. Sacrifice ratio and disinflation

- 1) To reduce inflation, policymakers can contract aggregate demand, causing unemployment to rise above the natural rate. The **sacrifice ratio** measures the percentage of a year's real GDP that must be forgone to reduce inflation by 1 percentage point. Sacrifice ratio = (lost GDP) / (total disinflation)
- 2) Example: To reduce inflation from 6% to 2%, must sacrifice 20% of one year's GDP: GDP loss = (inflation reduction) × (sacrifice ratio) = 4 × 5. This loss could be incurred in 1 year or spread over several (example: 5% loss for each of 4 years). The cost of disinflation is lost GDP. One could use Okun's law to translate this cost into unemployment.

3. Policy credibility and disinflation

- 1) Proponents of rational expectations believe that the sacrifice ratio may be very small: suppose $u = u_n$ and $\pi = E\pi = 6\%$, and suppose the Fed announces that it will do whatever is necessary to reduce inflation from 6% to 2% as soon as possible. If the announcement is credible, then $E\pi$ will fall, perhaps by the full 4 points. Then, π can fall without an increase in u .
- 2) Paul Walker's disinflation 1982-1985: Inflation fell by 6.7%, and total cyclical unemployment was 9.5%. Okun's law (1% of unemployment = 2% of lost output). Thus, 9.5% cyclical unemployment = 19.0% of a year's real GDP. Sacrifice ratio = (lost GDP) / (total disinflation) = $19/6.7 = 2.8$ percentage points of GDP were lost for each 1 percentage point reduction in inflation.

Table: sacrifice ratio for the Volcker disinflation

Year	Unemployment Rate u	Natural Rate u_n	Cyclical Unemployment $u - u_n$
1982	9.7%	6.0%	3.7%
1983	9.6	6.0	3.6
1984	7.5	6.0	1.5
1985	7.2	6.0	1.2
			Total 10.0%

- 3) Central banks that are politically independent are typically more credible than those that are puppets of elected officials. Hence, in countries with central banks that are NOT politically independent, it is usually far costlier to reduce inflation. A very worthwhile reform, therefore, would be for governments to give their central banks independence.

Theories of aggregate supply are controversial, and not all economists agree with the ideas presented in this chapter. Ten years from now, some of these ideas will probably be better integrated into our overall understanding of the economy, while others may have been discarded as a result of theoretical advances or because they have been refuted by economic events. New debates about aggregate supply will probably be provoking and puzzling economists. These debates, in one form or another, have been present in macroeconomics since Keynes first presented his challenge to the prevailing classical orthodoxy; we have made much progress since then, but much still eludes us.

Readings

*Phillips Curve by Kevin D. Hoover

<https://www.econlib.org/library/Enc/PhillipsCurve.html>

*The Hutchins Center Explains: The Phillips Curve

<https://www.brookings.edu/blog/up-front/2018/08/21/the-hutchins-center-explains-the-phillips-curve/>

Has the Wage Phillips Curve Gone Dormant?

<https://www.frbsf.org/economic-research/publications/economic-letter/2017/october/has-wage-phillips-curve-gone-dormant/>

How Have Shanghai, Saudi Arabia, and Supply Chains Affected U.S. Inflation Dynamics?

<https://research.stlouisfed.org/publications/review/2018/10/25/how-have-shanghai-saudi-arabia-and-supply-chains-affected-u-s-inflation-dynamics>

1976 Nobel Memorial Lecture by Milton Friedman: Inflation and Unemployment

<https://assets.nobelprize.org/uploads/2018/06/friedman-lecture-1.pdf>

Coibion, Olivier, Yuriy Gorodnichenko, and Rupal Kamdar. 2018. "The Formation of Expectations, Inflation, and the Phillips Curve." Journal of Economic Literature, 56 (4): 1447-91. DOI: 10.1257/jel.20171300

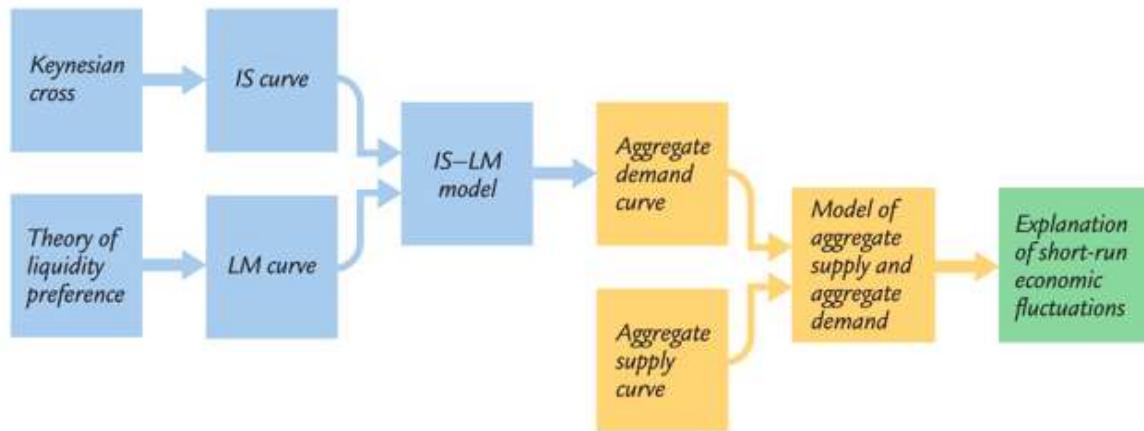
Lecture 12 IS-LM Model and Aggregate Demand

Biwei Chen (Updated: April 30)

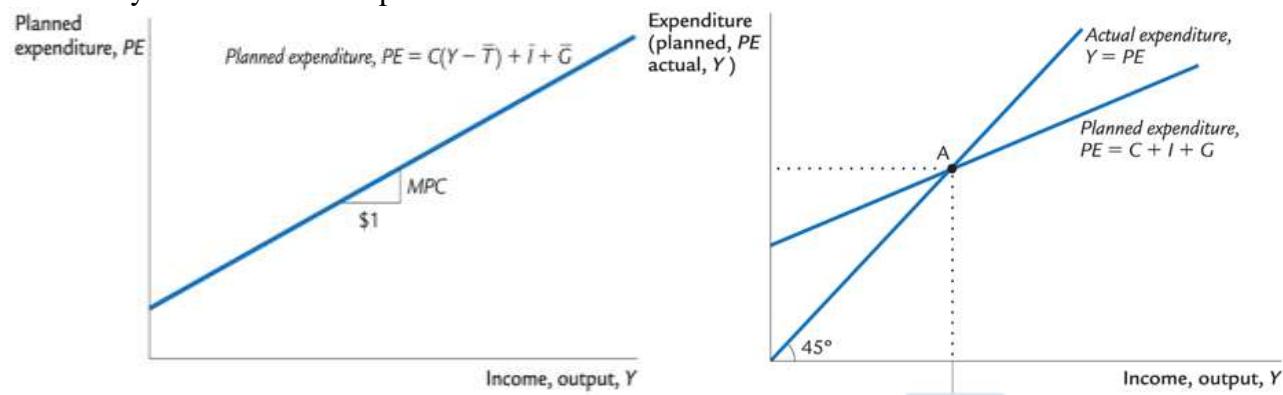
Reference: Mankiw, 2019, CH11&12 Aggregate Demand and IS-LM Model

In the short run prices are not completely flexible, changes in aggregate demand affect output, not just prices. To develop this short-run theory of the economy, we must now consider aggregate demand and supply in more detail. This lecture presents a more detailed analysis of aggregate demand based on the IS-LM model (*IS* stands for “investment” and “saving,” and the *IS* curve represents what’s going on in the market for goods and services. *LM* stands for “liquidity” and “money,” and the *LM* curve represents what’s happening to the supply and demand for money.) This model was developed by John Hicks in the 1930s as an interpretation of John Maynard Keynes’s seminal work, *The General Theory of Employment, Interest and Money*, and is based on an analysis of equilibrium in the goods and money markets, supposing that **the price level is fixed**. We can interpret the IS-LM model in two distinct ways: first, as a theory of GDP determination, supposing that the price level is fixed; second, as a theory of aggregate demand and so as part of an aggregate demand-aggregate supply model.

Figure: Keynesian Macroeconomics Theoretical Framework



I. The Keynesian Cross: recap lecture 3

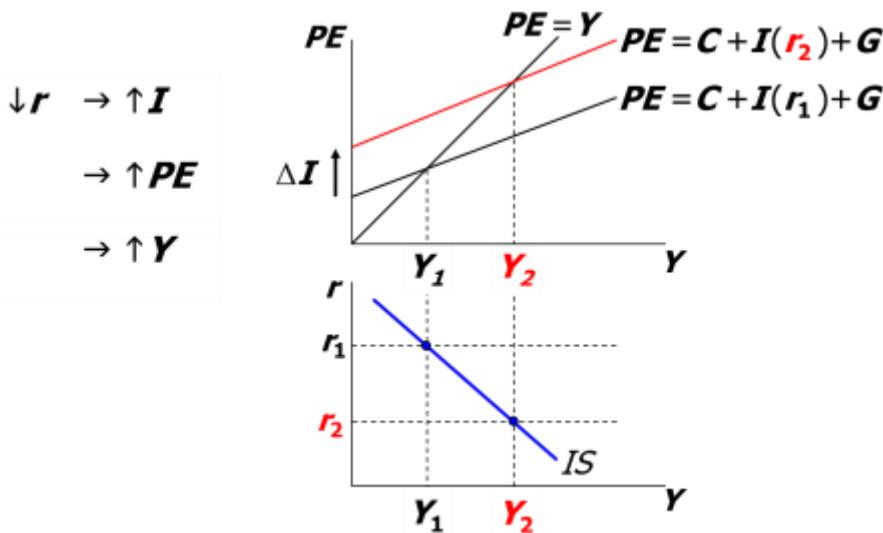


1. In equilibrium, planned expenditure = actual expenditure
2. Fiscal policy multipliers: Government expenditure $m_G = (1/1-MPC)$ and tax $m_T = (-MPC/1-MPC)$

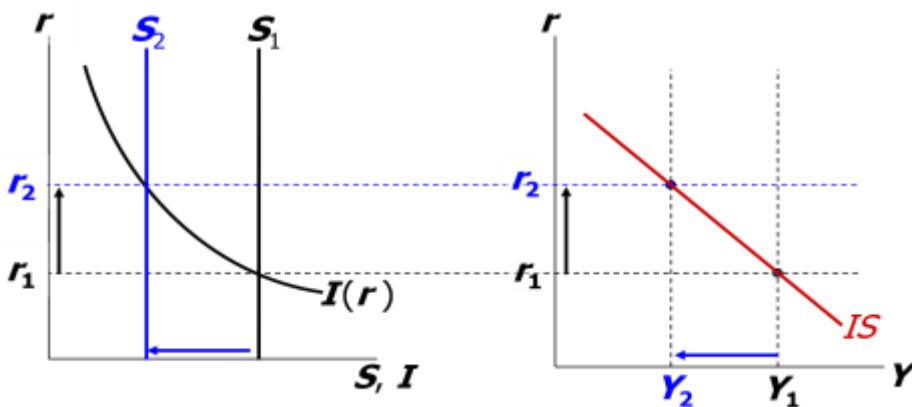
$$\Delta Y = \frac{1}{MPC} \Delta G \quad \Delta Y = \frac{-MPC}{1-MPC} \Delta T$$

II. The IS Curve

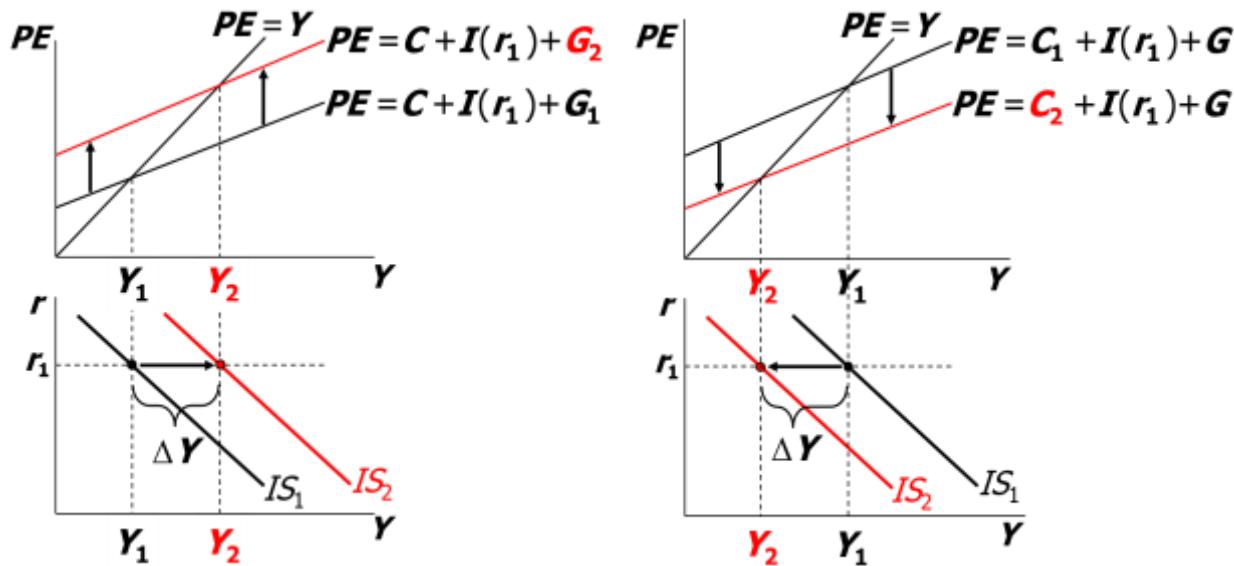
1. The IS curve: a graph of all combinations of r and Y that result in goods market equilibrium.
2. The IS equation: $Y = C(Y-T) + I(r) + G$, where G and T are pre-determined constants.
3. Derivation: from r - Y coordinate to PE- Y coordinate. Endogenous variables: r and Y . Process: A fall in the interest rate motivates firms to increase investment spending, which drives up total planned spending (PE). To restore equilibrium in the goods market, output (a.k.a. actual expenditure, Y) must increase.



4. IS curve derived from financial market equilibrium ($I=S$): interest rate balance investment and saving in financial market equilibrium. Changes in saving affect equilibrium interest rate, resulting in changes in investment (quantity demanded) and equilibrium real income.

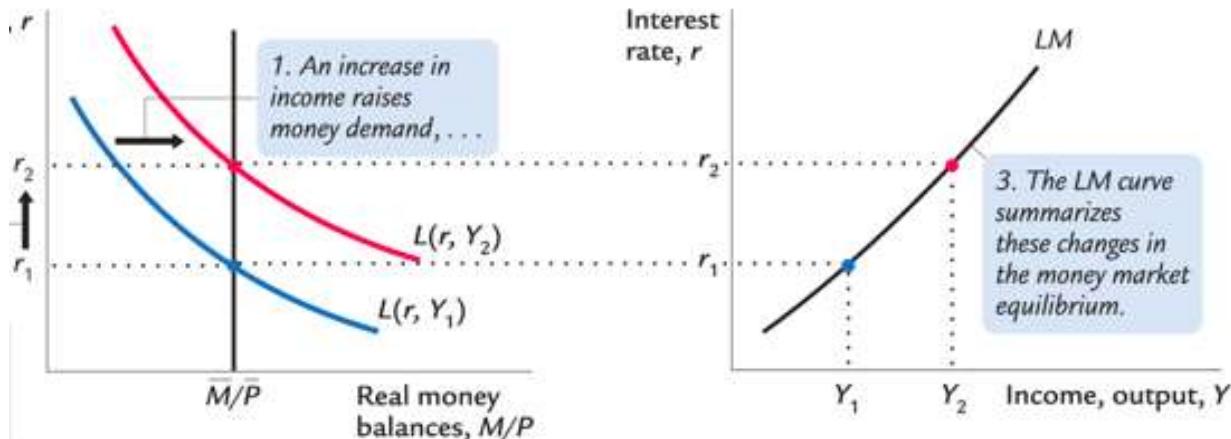


5. IS curve shifters: G and C



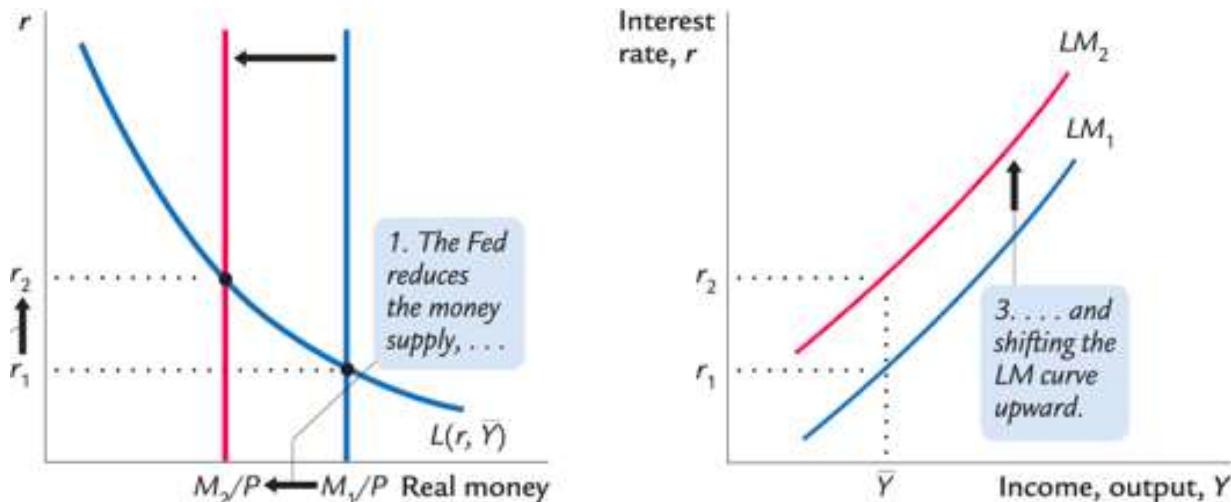
III. The LM Curve (money market equilibrium)

1. The LM curve is a graph of all combinations of r and Y that equate the supply and demand for real money balances (M/P).
2. The theory of liquidity preference: a simple theory in which the interest rate is determined by money supply and money demand. Recall that demand for money derives from transaction and liquidity preference. The nominal interest rate is the opportunity cost of holding money.
3. The LM equation: $M/P = L(i, Y)$, where M is the equilibrium quantity of money ($M_d = M_s$). In the short run, assuming price is fixed or zero inflation, nominal interest rate would equal real rate $i=r$. In equilibrium, interest rate balances demand and supply in the money market.



4. Derivation: higher income Y increases demand for money M_d , driving up interest rate in equilibrium. LM curve is drawn so it shares the same values of the interest rate as the market for real money balances. Equilibrium process: all else constant, an increase in income raises money demand. Since the supply of real balances is fixed, there is now excess demand in the money market at the initial interest rate. The interest rate must rise to restore equilibrium in the money market.

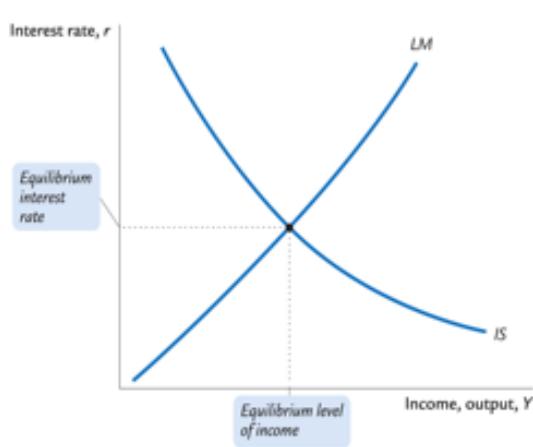
5. LM shifters: money supply and demand



- 1) When the Fed reduces M , what would happen to the equilibrium interest rate associated with a given value of income?
- 2) Suppose a wave of credit card fraud causes consumers to use cash more frequently in transactions. Use the liquidity preference model to show how these events shift the LM curve. **IMPORTANT!** Answer: If consumers desire to use cash more frequently, money demand will exogenously increase—that is, each (r, Y) pair will be associated with higher money demand than before. In the liquidity preference model, the money demand curve shifts upward/rightward. Hence, at the initial value of income, the interest rate must rise to restore equilibrium in the money market. As a result, the LM curve shifts up: each value of income (such as the initial income) is associated with a higher interest rate than before.

IV. The short-run equilibrium IS-LM model and applications

The short-run equilibrium is the combination of r and Y that simultaneously satisfies the equilibrium conditions in the goods and money markets.



IS curve comes from Keynesian cross when planned investment depends negatively on interest rate; shows all combinations of r and Y that equate planned expenditure with actual expenditure on goods and services.

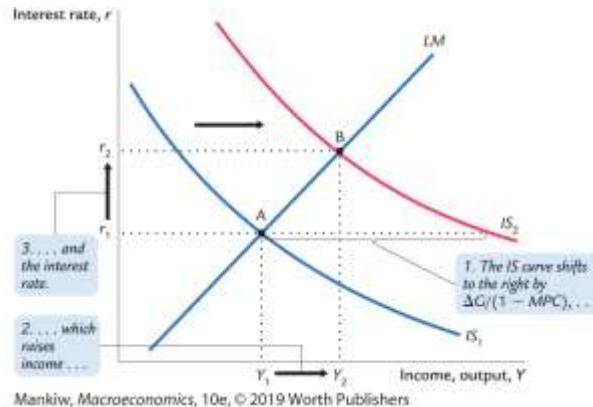
LM curve comes from liquidity preference theory when money demand depends positively on income; shows all combinations of r and Y that equate demand for real money balances with supply.

$$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$

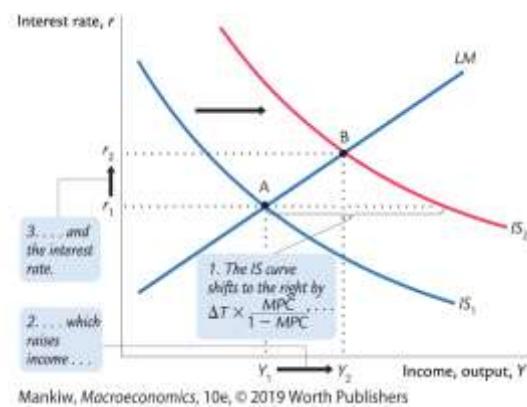
$$\bar{M}/\bar{P} = L(r, Y)$$

1. Effects of monetary and fiscal policy

- 1) Monetary and fiscal policy variables (M , G , and T) are exogenous
- 2) An increase in government expenditure and a reduction in tax: IS+

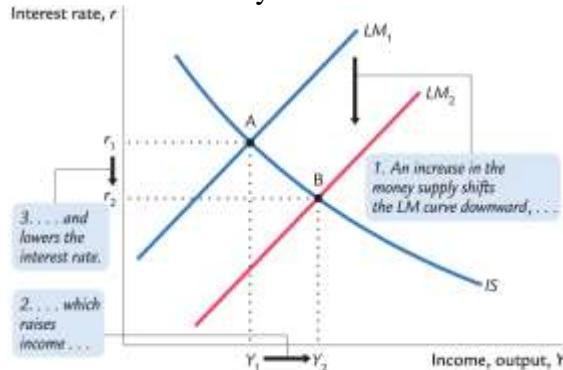


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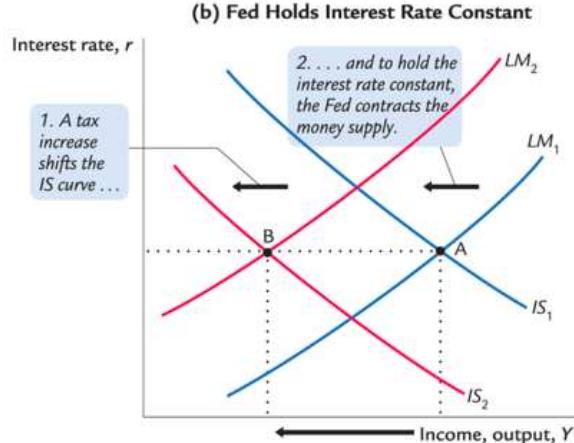
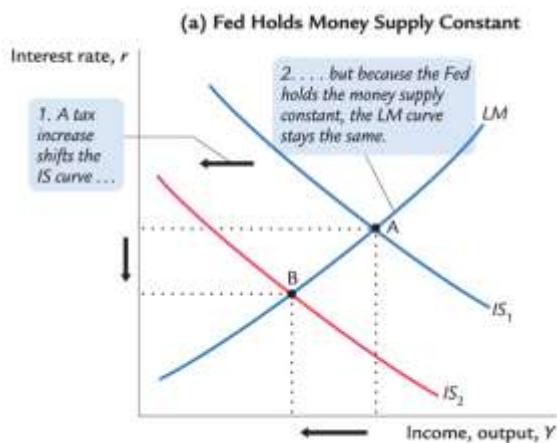
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- 3) An increase in money and credit: LM+



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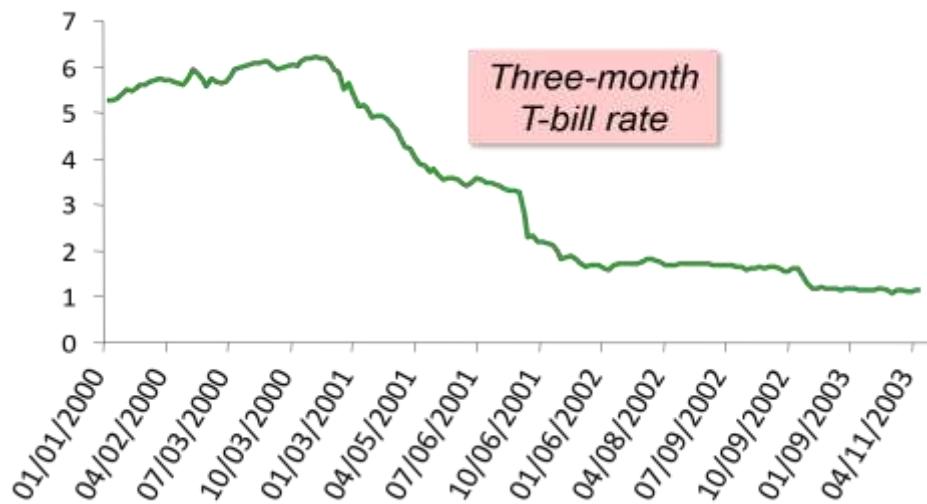
- 4) Policy combinations: Monetary policymakers may adjust M in response to changes in fiscal policy or vice versa. Such interactions may alter the impact of the original policy change. Suppose Congress increases G . The Fed can hold M constant (money stock targeting), or hold r constant (interest rate targeting), or hold Y (output) constant. In each case, the effects of ΔG are different.



2. Application: During the 2001 recession, 2.1 million jobs lost, unemployment rose from 3.9% to 5.8%. GDP growth slowed to 0.8% (compared to 3.9% average annual growth during 1994–2000). The 911 terrorist attack increased uncertainty and resulted in fall in consumer and business confidence. Corporate scandals (Enron and WorldCom) further reduced stock prices and investment. How did these conditions affect the IS curve?

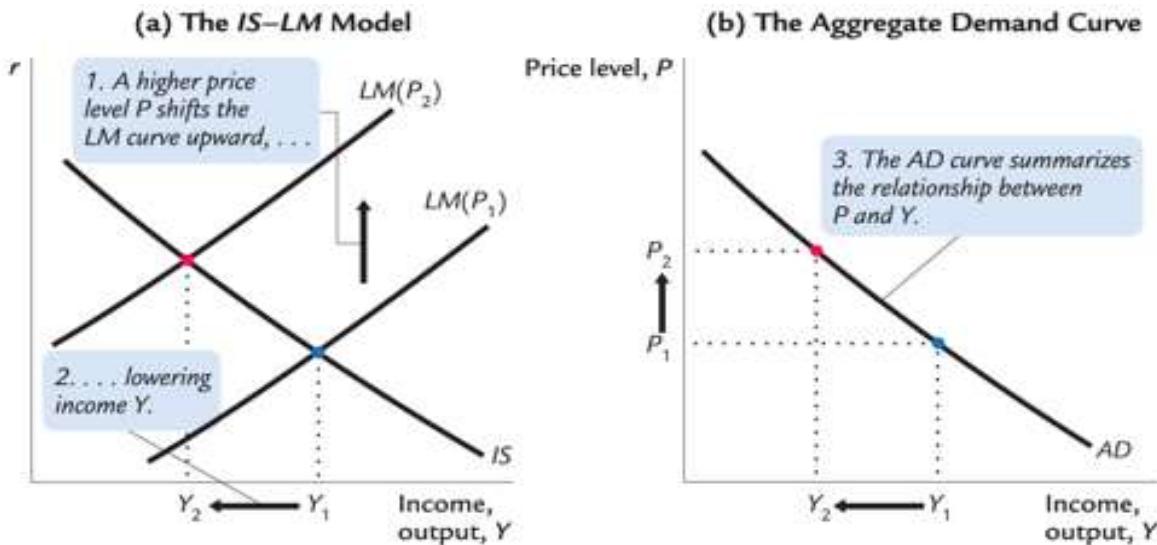


How did the Fed's policy change LM curve during the 2001 recession? How did the tax cuts along with Afghanistan war in 2001 shift IS curve?

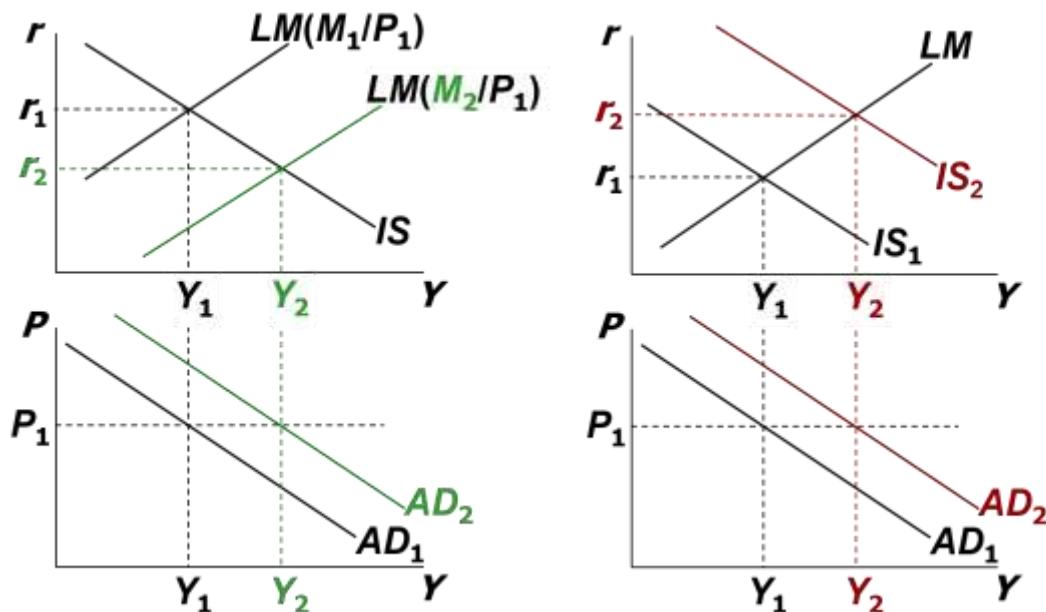


V. IS-LM Model and Aggregate Demand $\uparrow P \rightarrow \downarrow(M/P) \rightarrow \uparrow r \rightarrow \downarrow I \rightarrow \downarrow Y$

- When aggregate price is assumed sticky in the short run, economists can apply IS-LM model to analyze short-run fluctuations. However, a change in P would shift LM and would therefore affect Y . The aggregate demand curve captures this relationship between P and Y .
- The position of the LM curve depends on the value of M/P . M is an exogenous policy variable. Because the value of P affects the position of the LM curve, we label the LM curves in the upper panel as $LM(P_1)$ and $LM(P_2)$. Intuition: price rise will lead to higher interest rate (Fisher effect), given real income constant; price rise will lead to lower real income (income effect), given real interest rate constant. (LM equation: $M/P = ay - br$ or $r = (a/b)y - M/bP$. Rising P will shift LM up.)



3. Macroeconomic policy and AD curve
- 1) Fiscal policy: $G+$ or $T- \sim IS+ \sim AD+ \sim Y+$
 - 2) Monetary policy: $M+ \sim LM+ \sim r- \sim I+ \sim AD+ \sim Y+$



VI. Some comments on Keynesian theory

1. The cause of economic recession: inadequate aggregate demand (diminishing MPC and MEC)?
2. Investment is not equal to saving? (planned investment equals planned savings only in equilibrium). Paradox of thrift: consumption increases national income while saving reduces it.
3. Multiplier effects ($MPC < 1$) and broken window fallacy. <https://www.youtube.com/watch?v=erJEaFpS9ls>
4. Consumption function misspecification, which was rejected by permanent income hypothesis
5. Policy recommendation and abuse of countercyclical government budgets in practice

Readings

Keynesian Economics by Alan Blinder

<https://www.econlib.org/library/Enc/KeynesianEconomics.html>

New Classical Macroeconomics by Kevin D. Hoover

<https://www.econlib.org/library/Enc/NewClassicalMacroeconomics.html>

New Keynesian Economics by N. Gregory Mankiw

<https://www.econlib.org/library/Enc/NewKeynesianEconomics.html>

Models, Markets, and Monetary Policy by Richard H. Clarida

<https://www.federalreserve.gov/newsevents/speech/clarida20190503a.htm>

Helge Braun, Reinout De Bock, and Riccardo DiCecio, "Supply Shocks, Demand Shocks, and Labor Market Fluctuations," Federal Reserve Bank of St. Louis Review, May/June 2009, pp. 155-178.

<https://doi.org/10.20955/r.91.155-178>