

Business Cycles

One of the most controversial questions in macroeconomics is what explains business-cycle fluctuations.

Economists mostly agree on what are the key facts describing the phenomenon but a unifying explanation for the facts is still hotly debated.

What are the key facts?

Business-cycle facts describe the statistical regularities of the deviations of some key macro time series from a smooth trend line. Key properties

1. amplitude of fluctuations
2. comovements
3. lead and lag patterns

How to define the smooth trend line?

Literature has a number of answers. We will focus on results based on using the Hodrick-Prescott filter to define the smooth trend line. Intuitively, this is a way to extract the long-run growth portion of a series and to leave the cycle component. It can also be viewed as a way to take away “low frequency” components from the data.

AN HISTORICAL REPORT CARD ON REAL GDP AND UNEMPLOYMENT

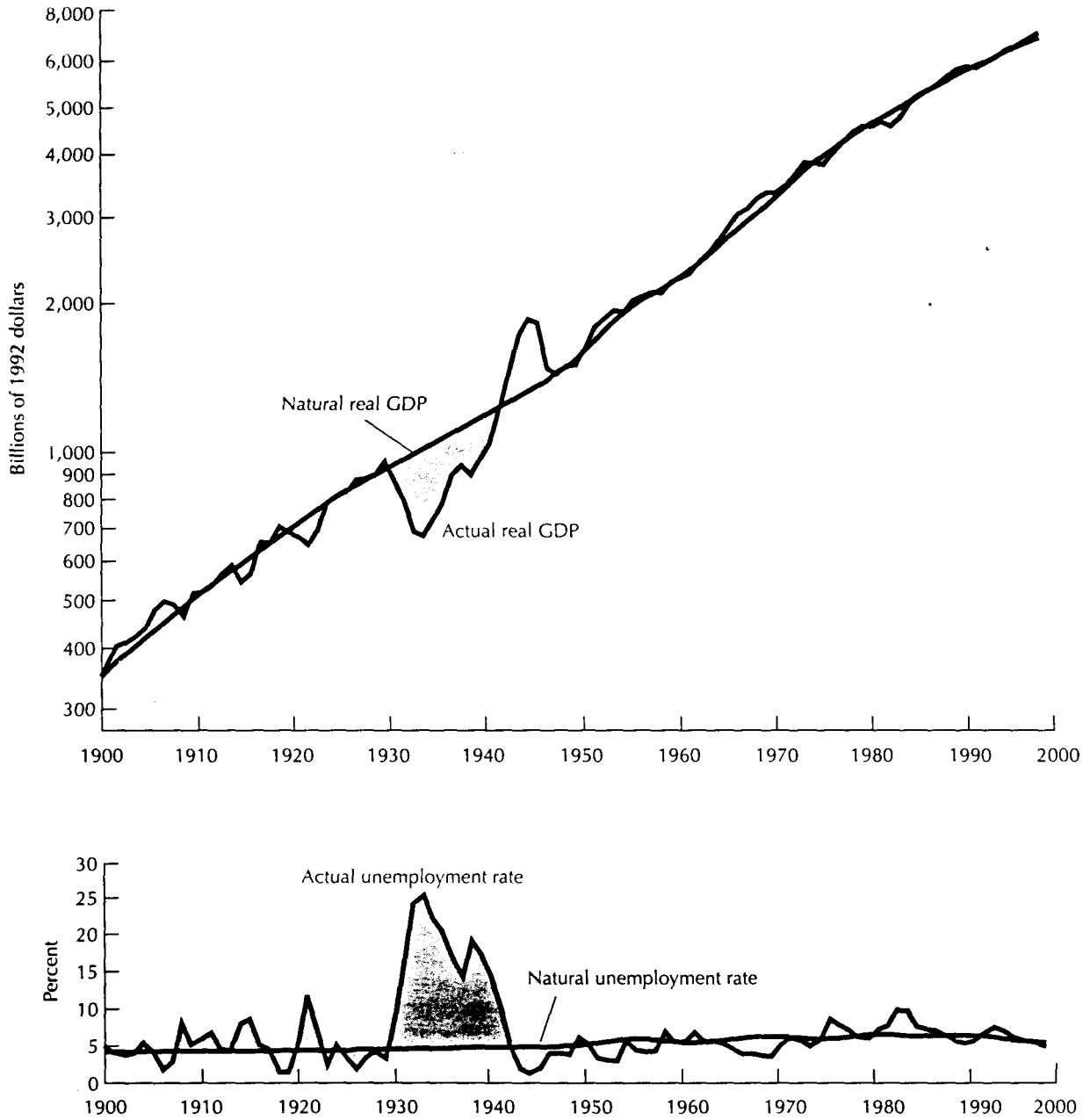
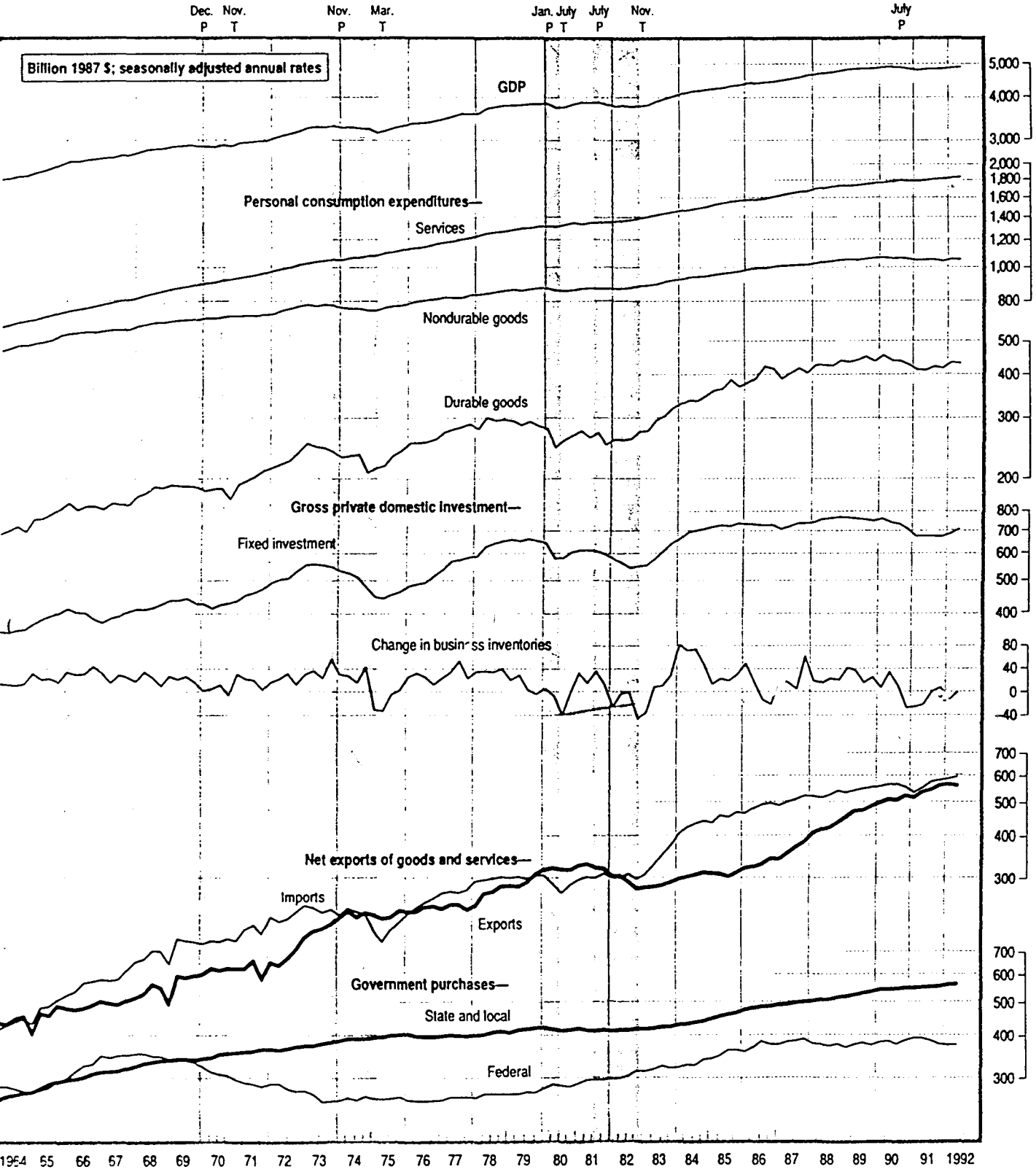


Figure 1-4 Actual and Natural GDP and Unemployment, 1900-98

An historical report card for two important economic magnitudes. In the top frame the black line indicates natural real GDP. The green line shows actual real GDP, which was well below natural real GDP during the Great Depression of the 1930s and well above it during World War II. In the bottom frame the black line indicates the natural rate of unemployment, and the green line indicates the actual unemployment rate. Actual unemployment was much higher during the Great Depression of the 1930s than at any other time during the century. Notice how periods of high actual unemployment like the 1930s, designated by gray areas in the bottom frame, occur simultaneously with periods of low actual real GDP in the top frame. Green areas indicate times when the economy was "overheated," with high actual real GDP and low unemployment.

NIPA Charts

REAL GDP AND ITS COMPONENTS: TRENDS AND CYCLES



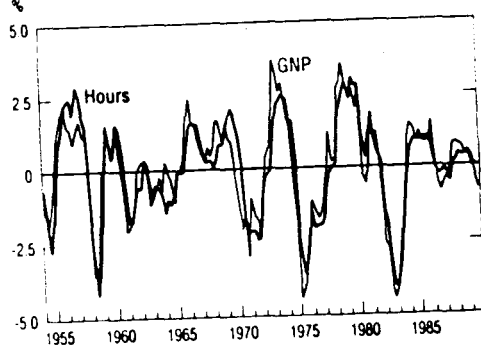
... a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own (p. 3).

Table 1
Cyclical Behavior of U.S. Production Inputs
Deviations From Trend of Input Variables
Quarterly, 1954-1989

Variable x	Volatility (% Std. Dev.)	Cross Correlation of Real GNP With										
		$x(t-5)$	$x(t-4)$	$x(t-3)$	$x(t-2)$	$x(t-1)$	$x(t)$	$x(t+1)$	$x(t+2)$	$x(t+3)$	$x(t+4)$	$x(t+5)$
Real Gross National Product	1.71	-0.03	0.15	0.38	0.63	0.85	1.00	0.85	0.63	0.38	0.15	-0.03
Labor Input												
Hours (Household Survey)	1.47	-0.10	0.05	0.23	0.44	0.69	0.86	0.86	0.75	0.59	0.38	0.18
Employment	1.06	-0.18	-0.04	0.14	0.36	0.61	0.82	0.89	0.82	0.67	0.47	0.25
Hours per Worker	0.54	0.08	0.21	0.35	0.49	0.66	0.71	0.59	0.43	0.29	0.11	-0.02
Hours (Establishment Survey)	1.65	-0.23	-0.07	0.14	0.39	0.66	0.88	0.92	0.81	0.64	0.42	0.21
GNP/Hours (Household Survey)	0.88	0.11	0.21	0.34	0.48	0.50	0.51	0.21	-0.02	-0.25	-0.34	-0.36
GNP/Hours (Establishment Survey)	0.83	0.40	0.46	0.49	0.53	0.43	0.31	-0.07	-0.31	-0.49	-0.52	-0.50
Average Hourly Real Compensation (Business Sector)	0.91	0.30	0.37	0.40	0.42	0.40	0.35	0.26	0.17	0.05	-0.08	-0.20
Capital Input												
Nonresidential Capital Stock*	0.62	-0.58	-0.61	-0.51	-0.48	-0.31	-0.08	0.16	0.39	0.56	0.66	0.70
Structures	0.37	-0.45	-0.51	-0.55	-0.53	-0.44	-0.29	-0.10	0.09	0.25	0.38	0.45
Producers' Durable Equipment	0.99	-0.57	-0.58	-0.53	-0.41	-0.22	0.02	0.26	0.47	0.62	0.70	0.71
Inventory Stock (Nonfarm)	1.65	-0.37	-0.33	-0.23	-0.05	0.19	0.50	0.72	0.83	0.81	0.71	0.53

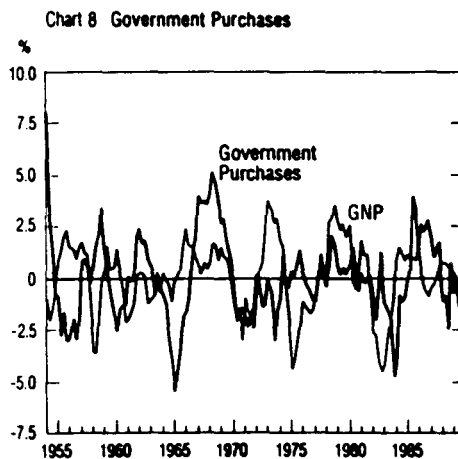
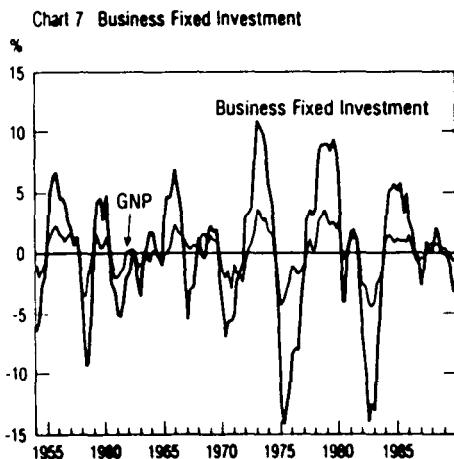
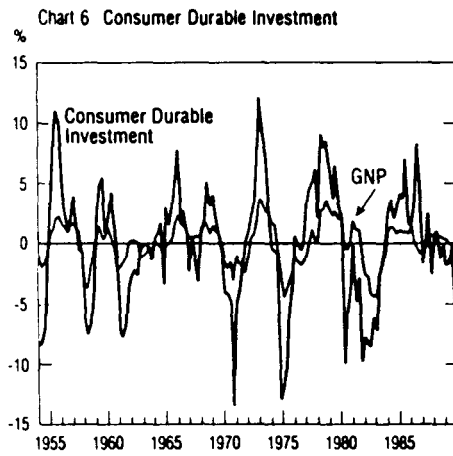
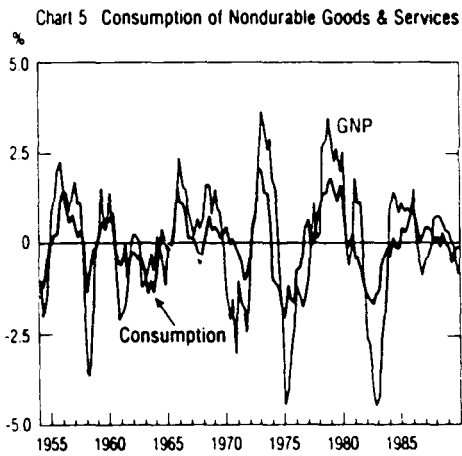
*Based on quarterly data, 1954:1-1984:2.
Source of basic data: Citicorp's Citibase data bank

Chart 3
 Deviations From Trend of U.S. Real Gross National Product
 and Hours Worked*
 Quarterly, 1954-1989



*The estimate of hours worked uses the establishment survey.
 Source of basic data: Citicorp's Citibase data bank

Charts 5-8
 Deviations From Trend of U.S. Real Gross National Product
 and Its Components
 Quarterly, 1954-1989



Source of basic data: Citicorp's Citibase data bank

Table 2
 Cyclical Behavior of U.S. Output and Income Components
 Deviations From Trend of Product and Income Variables
 Quarterly, 1954-1989

Variable x	Volatility (% Std. Dev.)	Cross Correlation of Real GNP With										
		$x(t-5)$	$x(t-4)$	$x(t-3)$	$x(t-2)$	$x(t-1)$	$x(t)$	$x(t+1)$	$x(t+2)$	$x(t+3)$	$x(t+4)$	$x(t+5)$
Real Gross National Product	1.71	-0.03	0.15	0.38	0.63	0.85	1.00	0.85	0.63	0.38	0.15	-0.03
Consumption Expenditures	1.25	0.25	0.41	0.56	0.71	0.81	0.82	0.66	0.45	0.21	-0.02	-0.21
Nondurables & Services	0.84	0.20	0.38	0.53	0.67	0.77	0.76	0.63	0.46	0.27	0.06	-0.12
Nondurables	1.23	0.29	0.42	0.52	0.62	0.69	0.69	0.57	0.38	0.16	-0.05	-0.22
Services	0.63	0.03	0.25	0.46	0.63	0.73	0.71	0.60	0.49	0.39	0.23	0.07
Durables	4.99	0.25	0.38	0.50	0.64	0.74	0.77	0.60	0.37	0.10	-0.14	-0.32
Investment Expenditures	8.30	0.04	0.19	0.39	0.60	0.79	0.91	0.75	0.50	0.21	-0.05	-0.26
Fixed Investment	5.38	0.09	0.25	0.44	0.64	0.83	0.90	0.81	0.60	0.35	0.08	-0.14
Nonresidential	5.18	-0.26	-0.13	0.05	0.31	0.57	0.80	0.88	0.83	0.68	0.46	0.23
Structures	4.75	-0.40	-0.31	-0.17	0.03	0.29	0.52	0.65	0.69	0.63	0.50	0.34
Equipment	6.21	-0.18	-0.04	0.14	0.39	0.65	0.85	0.90	0.81	0.62	0.38	0.15
Residential	10.89	0.42	0.56	0.66	0.73	0.73	0.62	0.37	0.10	-0.15	-0.34	-0.45
Government Purchases	2.07	0.00	-0.03	-0.03	-0.01	-0.01	0.05	0.09	0.12	0.17	0.27	0.34
Federal	3.68	0.00	-0.05	-0.08	-0.09	-0.09	-0.02	0.03	0.06	0.10	0.19	0.24
State & Local	1.19	0.06	0.10	0.17	0.25	0.26	0.25	0.20	0.16	0.19	0.27	0.36
Exports	5.53	-0.50	-0.46	-0.34	-0.14	0.11	0.34	0.48	0.53	0.53	0.53	0.45
Imports	4.92	0.11	0.18	0.30	0.45	0.61	0.71	0.71	0.51	0.28	0.03	-0.19
Real Net National Income												
Labor Income*	1.58	-0.18	-0.02	0.18	0.42	0.68	0.88	0.90	0.80	0.62	0.40	0.19
Capital Income**	2.93	0.10	0.24	0.44	0.63	0.79	0.84	0.60	0.30	0.02	-0.19	-0.29
Proprietors' Income & Misc.†	2.70	0.11	0.24	0.38	0.55	0.62	0.68	0.46	0.29	0.11	0.02	-0.10

*Employee compensation is deflated by the implicit GNP price deflator.

**This variable includes corporate profits with inventory valuation and capital consumption adjustments, plus rental income of persons with capital consumption adjustment, plus net interest, plus capital consumption allowances with capital consumption adjustment, all deflated by the implicit GNP price deflator.

†Proprietors' income with inventory valuation and capital consumption adjustments, plus indirect business tax and nontax liability, plus business transfer payments, plus current surplus of government enterprises, less subsidies, plus statistical discrepancy.

Source of basic data: Citicorp's Citibase data bank

Table 4
 Cyclical Behavior of U.S. Monetary Aggregates and the Price Level
 Deviations From Trend of Money Stock, Velocity, and Price Level
 Quarterly, 1954-1989

Variable x	Volatility (% Std. Dev.)	Cross Correlation of Real GNP With										
		$x(t-5)$	$x(t-4)$	$x(t-3)$	$x(t-2)$	$x(t-1)$	$x(t)$	$x(t+1)$	$x(t+2)$	$x(t+3)$	$x(t+4)$	$x(t+5)$
Nominal Money Stock*												
Monetary Base	0.88	-0.12	0.02	0.14	0.25	0.36	-0.41	0.40	0.37	0.32	0.28	0.26
M1	1.68	0.01	0.12	0.23	0.33	0.35	0.31	0.22	0.15	0.09	0.07	0.07
M2	1.51	0.48	0.60	0.67	-0.68	0.61	0.46	0.26	0.05	-0.15	-0.33	-0.46
M2 - M1	1.91	0.53	0.63	0.67	0.65	0.56	0.40	0.20	-0.01	-0.21	-0.39	-0.53
Velocity*												
Monetary Base	1.33	-0.26	-0.15	0.00	0.22	0.40	0.59	0.50	0.37	0.22	0.08	-0.08
M1	2.02	-0.24	-0.19	-0.12	-0.01	0.14	0.31	0.32	0.27	0.20	0.10	0.00
M2	1.84	-0.63	-0.59	-0.48	-0.29	-0.05	0.24	0.34	0.40	0.43	0.44	0.43
Price Level												
Implicit GNP Deflator	0.89	-0.50	-0.61	-0.68	-0.69	-0.64	-0.55	-0.43	-0.31	-0.17	-0.04	0.09
Consumer Price Index	1.41	-0.52	-0.63	-0.70	-0.72	-0.68	-0.57	-0.41	-0.24	-0.05	0.14	0.30

*Based on quarterly data, 1959:1-1989:4.

Source of basic data: Citicorp's Citibase data bank

Key US Facts:

1. Labor hours are about as variable as output and are strongly procyclical. Labor productivity is procyclical.
2. Consumption is less variable than output but investment is much more variable than output.
3. Consumption and investment are procyclical. Government spending is acyclical.

4. Measures of money are procyclical but prices are countercyclical.

Two Other Data Issues:

1. Have business-cycle fluctuations changed in magnitude or nature over time in US data?
2. Is the systematic movement in quarterly GDP (the seasonal cycle) smaller or larger than business-cycle fluctuations?

AN HISTORICAL REPORT CARD ON REAL GDP AND UNEMPLOYMENT

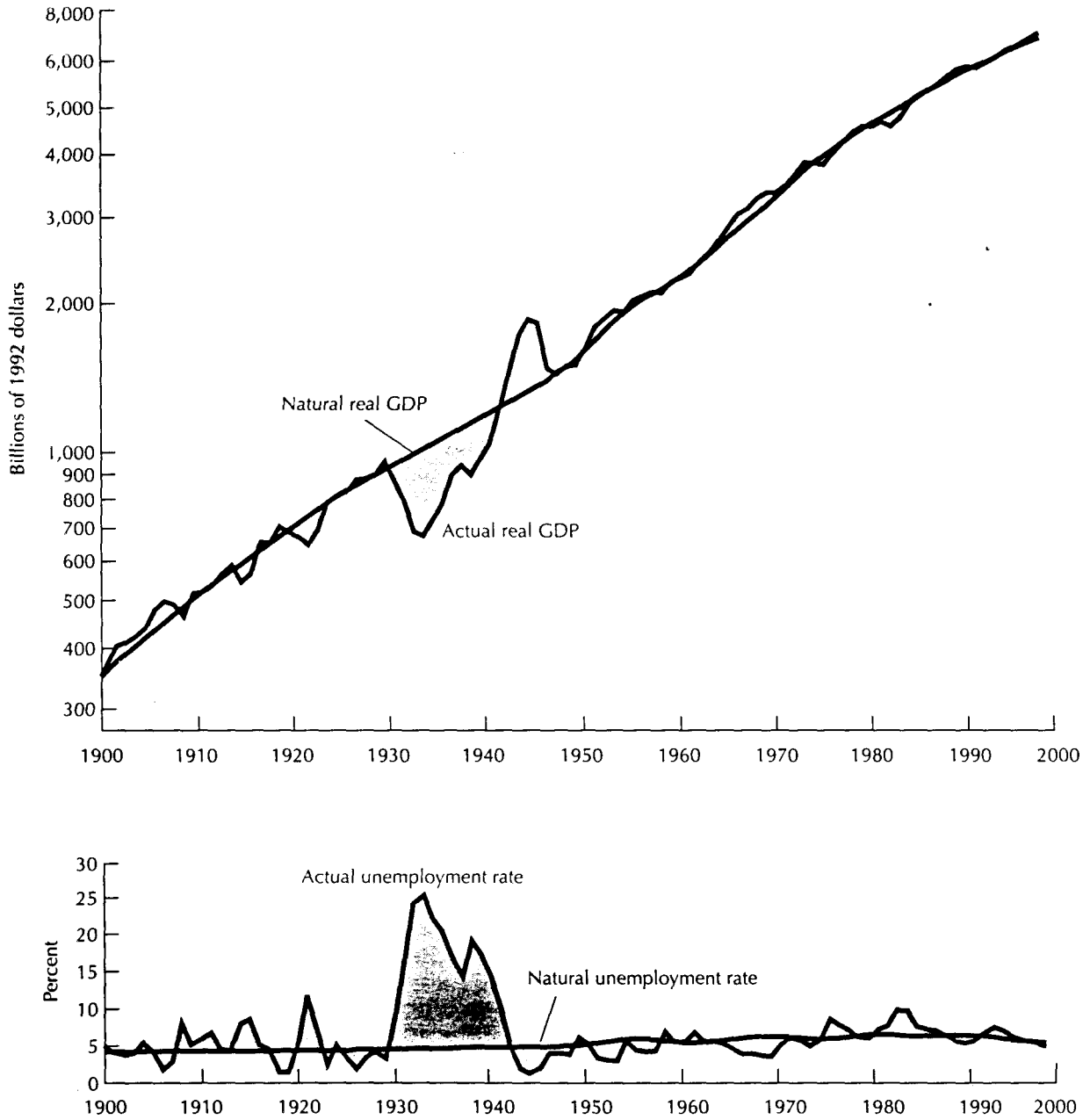


Figure 1-4 Actual and Natural GDP and Unemployment, 1900-98

An historical report card for two important economic magnitudes. In the top frame the black line indicates natural real GDP. The green line shows actual real GDP, which was well below natural real GDP during the Great Depression of the 1930s and well above it during World War II. In the bottom frame the black line indicates the natural rate of unemployment, and the green line indicates the actual unemployment rate. Actual unemployment was much higher during the Great Depression of the 1930s than at any other time during the century. Notice how periods of high actual unemployment like the 1930s, designated by gray areas in the bottom frame, occur simultaneously with periods of low actual real GDP in the top frame. Green areas indicate times when the economy was "overheated," with high actual real GDP and low unemployment.

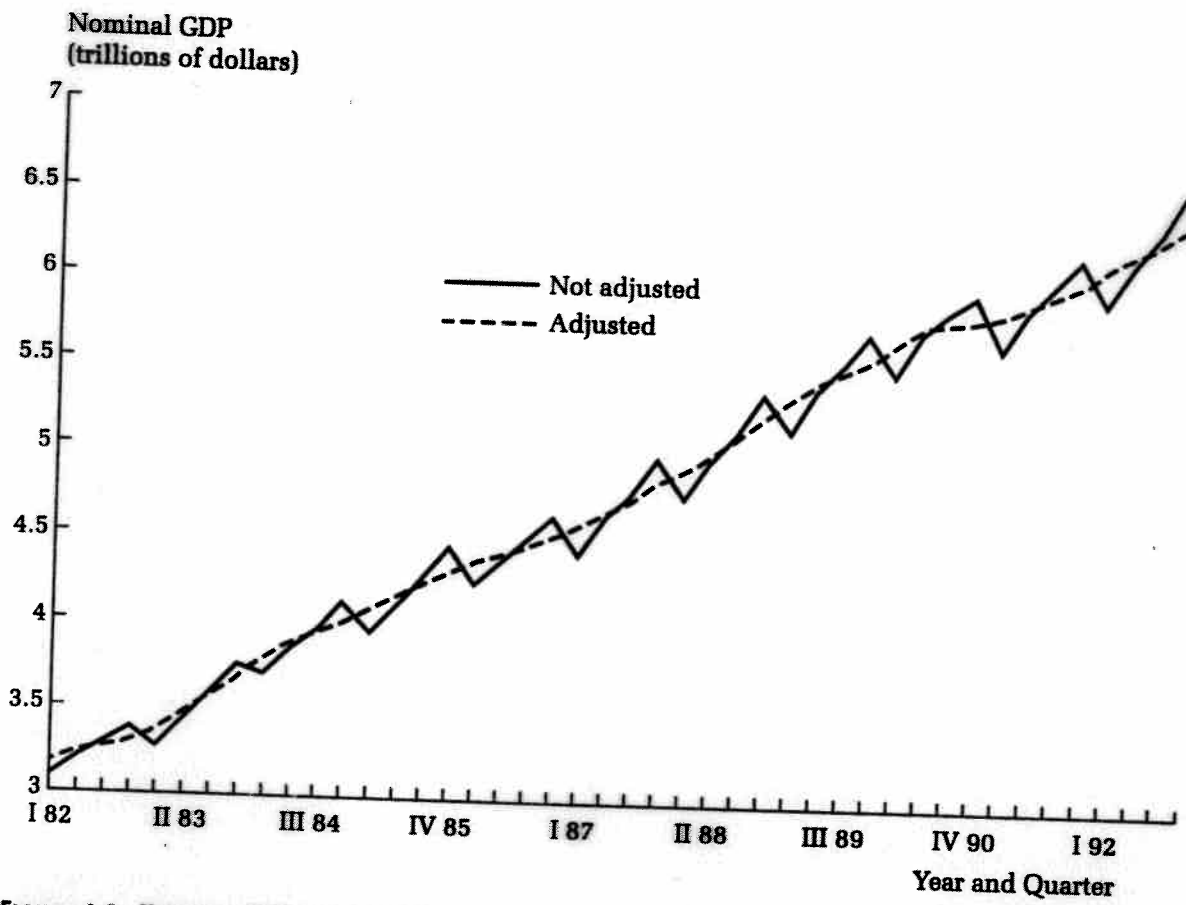


FIGURE 4.8 NOMINAL GDP, 1982-1992

The solid line depicts raw data on GDP; the dashed line depicts seasonally adjusted data. Comparing the two shows that seasonal fluctuations are quite predictable and large.

Source: *National Income and Product Accounts*.

Procyclical Productivity Puzzle:

The data tell us that at business-cycle frequencies labor hours move a lot and are procyclical but that capital input moves little and is acyclical. If we adopt a neoclassical aggregate production function, then how can we explain why in the data labor productivity (Y/L) is procyclical?

A Problem:

Any theory with an unchanging, CRS production function $Y_t = F(K_t, L_t)$ with diminishing marginal products will be problematic.

Qualifying Proviso: capital input varies little in percentage terms.

Two Possible Solutions:

1. $Y_t = A_t F(K_t, L_t)$ and A_t varies (procyclically).

2. $Y_t = F(K_t, L_t)$ w/ increasing returns to labor alone!!!!!!!

Theory 1: Life-Cycle Model w/ Productivity 'Shocks'

- standard Life-Cycle model (rational choice)
- technology $Y_t = A_t F(K_t, L_t) = A_t K_t^\beta L_t^{1-\beta}$
- impulses: A_t
- propagation: capital accumulation + consumption smoothing

Propagation:

Even temporary shocks have long-lasting effects.

A positive productivity shock raises wages. Young agents convert some of the rise in wages into additional consumption in old age, if consumption is a normal good. Thus, a temporary shock leads to greater savings in physical capital. Capital is how the shock propagates to affect future wages.

Policy:

If the Life-Cycle model with shocks is the theory of business cycles, then attempts to smooth out business cycle fluctuations will not in this (oversimplified??) model lead to Pareto improvements. Recall the Proposition established in Ch. 5!!

Theory 2: Old-Time Keynesian Story

- no rational choice theory (abandon microeconomics)
- no aggregate production function
- impulses: animal spirits of investors
- propagation: unclear as the model is static

“The fundamental psychological law, upon which we are entitled to depend with great confidence both a priori and from our knowledge of human nature and from the detailed facts of experience, is that men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income.” - Keynes (1936, Chapter 8, p. 96.).

“Even apart from the instability due to speculation, there is the instability due to the characteristic of human nature that a large proportion of our positive activities depend on spontaneous optimism rather than on a mathematical expectation, whether moral or hedonistic or economic. Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits - of a spontaneous urge to action rather than inaction, and

not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities.”

- Keynes (1936, Chapter 12, p. 161)

Stylized Keynesian Model

$$C + I + G = Y$$

$$C = C(Y, T) = a + b(Y - T) \text{ - consumption decision rule}$$

$$I = I, G = G, T = G$$

Solve for Output Y :

$$a + b(Y - G) + I + G = Y \text{ or } Y = \frac{a + I + (1 - b)G}{1 - b}$$

Policy:

Keynesians typically take the view that attempts to smooth out business cycle fluctuations are sensible. Politicians love the advice to increase government expenditures in recessions!

Note: this policy advice is not based on clear microeconomic principles.

Are Gains to Business-cycle Smoothing Large?

Although the source(s) of business-cycle fluctuations are controversial, could we figure out whether or not the maximum potential gain to (magically) eliminating these fluctuations is large?

Robert Lucas asked this question and made a back-of-the-envelope calculation. His answer was that the maximum potential gain was worth about \$8.50 per person!

Method: Expected Utility Theory

Expected Utility: $E[U(c)] = U(c_{low})P(low) + U(c_{high})P(high)$

Probability: $P(low) = P(high) = 1/2$

Utility: $U(c) = \log(c)$

Consumption: $c(low) = 98$ and $c(high) = 102$

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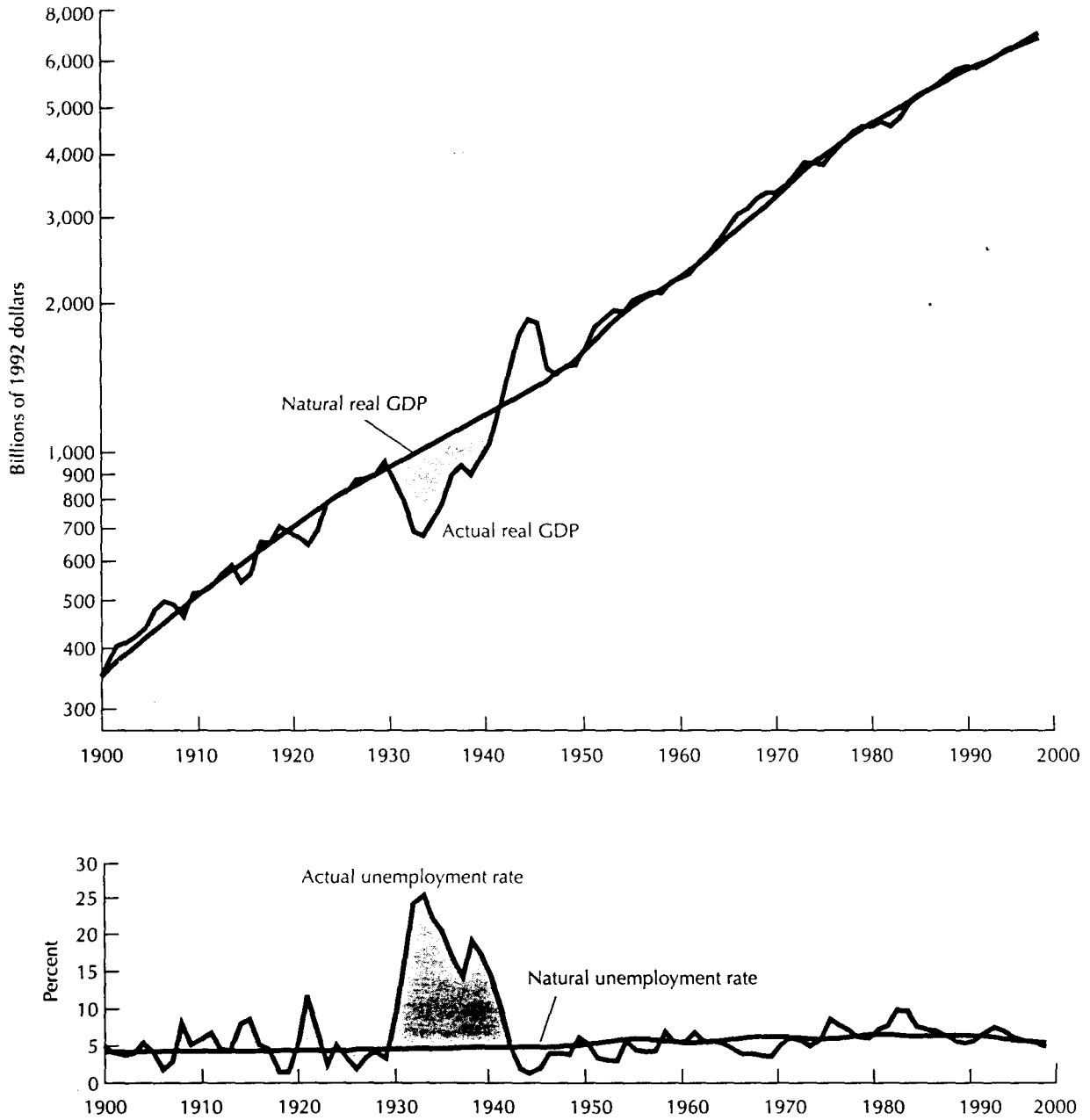


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Gain to getting $c = 100$ for sure?

$$E[U(\lambda c)] = U(\lambda c_{low})P(low) + U(\lambda c_{high})P(high) = U(100)$$

$$U(\lambda 98) \times .5 + U(\lambda 102) \times .5 = U(100)$$

$$\log(\lambda) + [\log(98) + \log(102)] \times .5 = \log(100)$$

$$\log(\lambda) = 2 - [1.99122 + 2.00860] \times .5 = .00009$$

Answer: Compensation $\lambda \doteq .00009$.

This is less than one hundredth of one percent of consumption.

Lucas: \$8.50 is a tenth of a percent of consumption/person in US in 1983.

Lucas: Max gain is worth about the cost of lunch, assuming people are about 10 times more risk averse than the case of log utility.