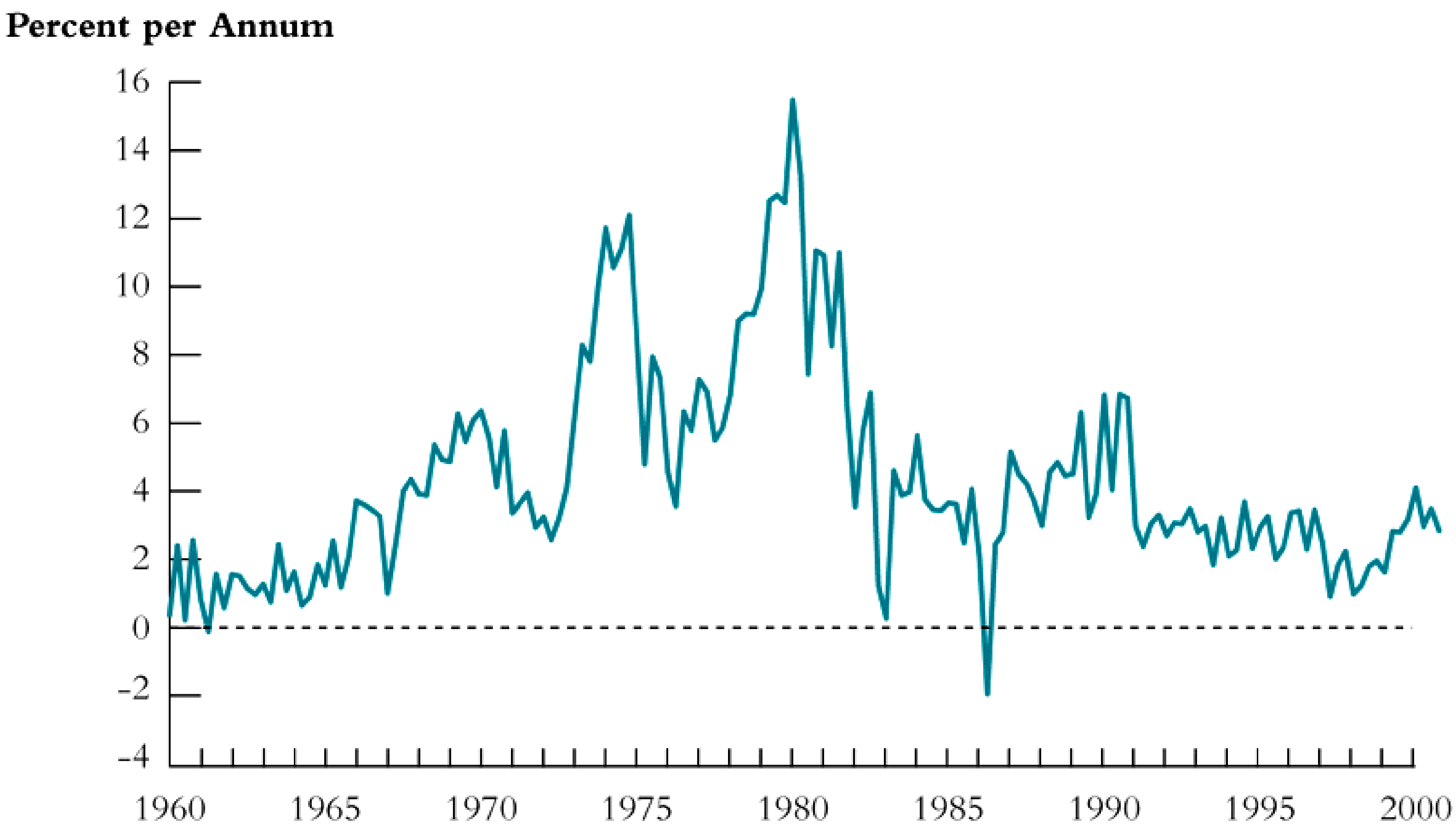
Example #1 of time series data: US rate of inflation

FIGURE 12.1 **Inflation and Unemployment in the United States, 1960–1999**

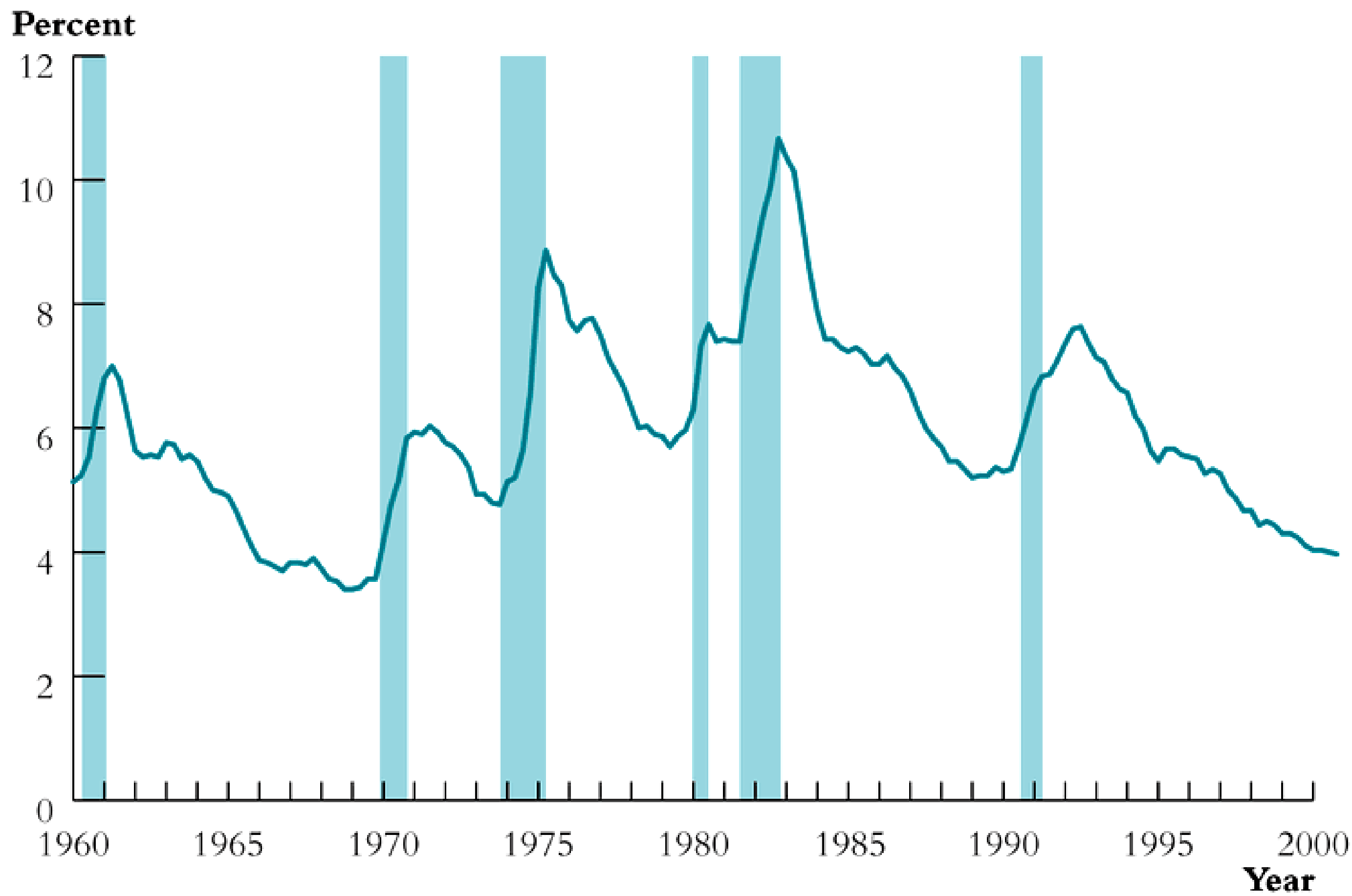


(a) U.S. CPI Inflation Rate

Price inflation in the United States (Figure 12.1a) drifted upwards from 1960 until 1980, and then fell sharply during the early 1980s.The unemployment rate in the United States (Figure 12.1b) rises during recessions (the shaded episodes) and falls during expansions.

Example #2: US rate of unemployment

FIGURE 12.1 **Inflation and Unemployment in the United States, 1960–1999**

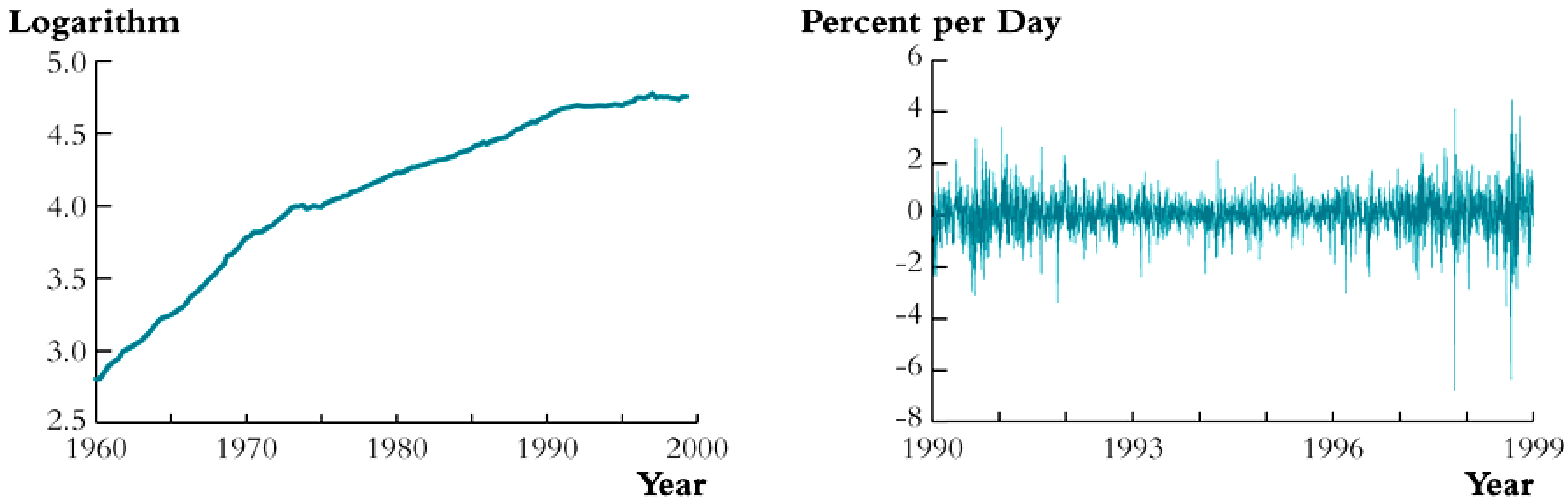


(b) U.S. Unemployment Rate

Price inflation in the United States (Figure 12.1a) drifted upwards from 1960 until 1980, and then fell sharply during the early 1980s.The unemployment rate in the United States (Figure 12.1b) rises during recessions (the shaded episodes) and falls during expansions.

More examples of time series & transformations, ctd.

FIGURE 12.2 **Four Economic Time Series**



(c) Logarithm of Real GDP in Japan

(d) Percentage Changes in Daily Values of the NYSE Composite Stock Index

The four time series have markedly different patterns. The Federal Funds Rate (Figure 12.2a) has a pattern similar to price inflation. The exchange rate between the U.S. dollar and the British pound (Figure 12.2b) shows a discrete change after the 1972 collapse of the Bretton Woods system of fixed exchange rates. The logarithm of real GDP in Japan (Figure 12.2c) shows relatively smooth growth, although the growth rate decreases in the 1970s and again in the 1990s. The daily returns on the NYSE stock price index (Figure 12.2d) are essentially unpredictable, but its variance changes: this series shows "volatility clustering."

Example: AR(1) model of inflation – STATA

First, let STATA know you are using time series data

`generate time=q(1959q1)+_n-1;`	*_n is the observation no. So this command creates a new variable time that has a special quarterly date format*
`format time %tq;`	*Specify the quarterly date format*
`sort time;`	*Sort by time*
`tsset time;`	*Let STATA know that the variable time is the variable you want to indicate the time scale*

Example: AR(1) model of inflation – STATA, ctd.

```
gen lcpi = log(cpi);                              variable cpi is already in memory

gen inf = 400*(lcpi[_n]-lcpi[_n-1]);  quarterly rate of inflation at an
                                                   annual rate

corrgram inf   , noplot lags(8);        computes first 8 sample autocorrelations

 LAG       AC       PAC      Q     Prob>Q
-----------------------------------------
 1      0.8459   0.8466   116.64  0.0000
 2      0.7663   0.1742   212.97  0.0000
 3      0.7646   0.3188   309.48  0.0000
 4      0.6705  -0.2218   384.18  0.0000
 5      0.5914   0.0023   442.67  0.0000
 6      0.5538  -0.0231   494.29  0.0000
 7      0.4739  -0.0740   532.33  0.0000
 8      0.3670  -0.1698    555.3  0.0000
```

```
gen inf = 400*(lcpi[_n]-lcpi[_n-1])
```

This syntax creates a new variable, inf, the "nth" observation of which is 400 times the difference between the nth observation on lcpi and the "n-1"th observation on lcpi, that is, the first difference of lcpi

Example: AR(1) model of inflation – STATA, ctd

Syntax: **L.d.inf is the first lag of d.inf ;**
d.inf is the first difference of inf

```
. reg d.inf L.d.inf if tin(1962q1,1999q4), r;

Regression with robust standard errors                 Number of obs =     152
                                                       F(  1,   150) =    3.96
                                                       Prob > F      =  0.0484
                                                       R-squared     =  0.0446
                                                       Root MSE      =  1.6619

------------------------------------------------------------------------------
             |               Robust
dinf         |      Coef.   Std. Err.       t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
dinf         |
          L1 |  -.2109525   .1059828    -1.99   0.048    -.4203645   -.0015404
_cons        |   .0188171   .1350643     0.14   0.889    -.2480572    .2856914
------------------------------------------------------------------------------
```

if tin(1962q1,1999q4)

STATA time series syntax for using only observations between 1962q1 and 1999q4 (inclusive).

This requires defining the time scale first, as we did above

Example: AR(4) model of inflation – STATA

```
. reg dinf L(1/4).d.inf if tin(1962q1,1999q4), r;

Regression with robust standard errors                 Number of obs =     152
                                                       F(  4,   147) =    6.79
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.2073
                                                       Root MSE      =  1.5292

------------------------------------------------------------------------------
             |               Robust
d.inf        |      Coef.   Std. Err.       t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 inf         |
         L1D |  -.2078575     .09923    -2.09   0.038    -.4039592   -.0117558
         L2D |  -.3161319   .0869203    -3.64   0.000    -.4879068    -.144357
         L3D |   .1939669   .0847119     2.29   0.023     .0265565    .3613774
         L4D |  -.0356774   .0994384    -0.36   0.720    -.2321909    .1608361
_cons        |   .0237543   .1239214     0.19   0.848    -.2211434     .268652
------------------------------------------------------------------------------
```

NOTES

- **L(1/4).d.inf** ***is A convenient way to say "use lags 1–4 of d.inf as regressors"***
- ***L1,…,L4 refer to the first, second,… 4th lags of d.inf***

Example: AR(4) model of inflation – STATA, ctd.

```
.  dis "Adjusted Rsquared = " _result(8);   result(8) is the rbar-squared
Adjusted Rsquared = .18576822               of the most recently run regression

test L2D. L3D. L4D.  ;   L2.d.inf is the second lag of d.inf, etc.

 ( 1)  L2D. inf = 0.0
 ( 2)  L3D. inf = 0.0
 ( 3)  L4D. inf = 0.0

       F(  3,   147) =    6.43
            Prob > F =    0.0004
```

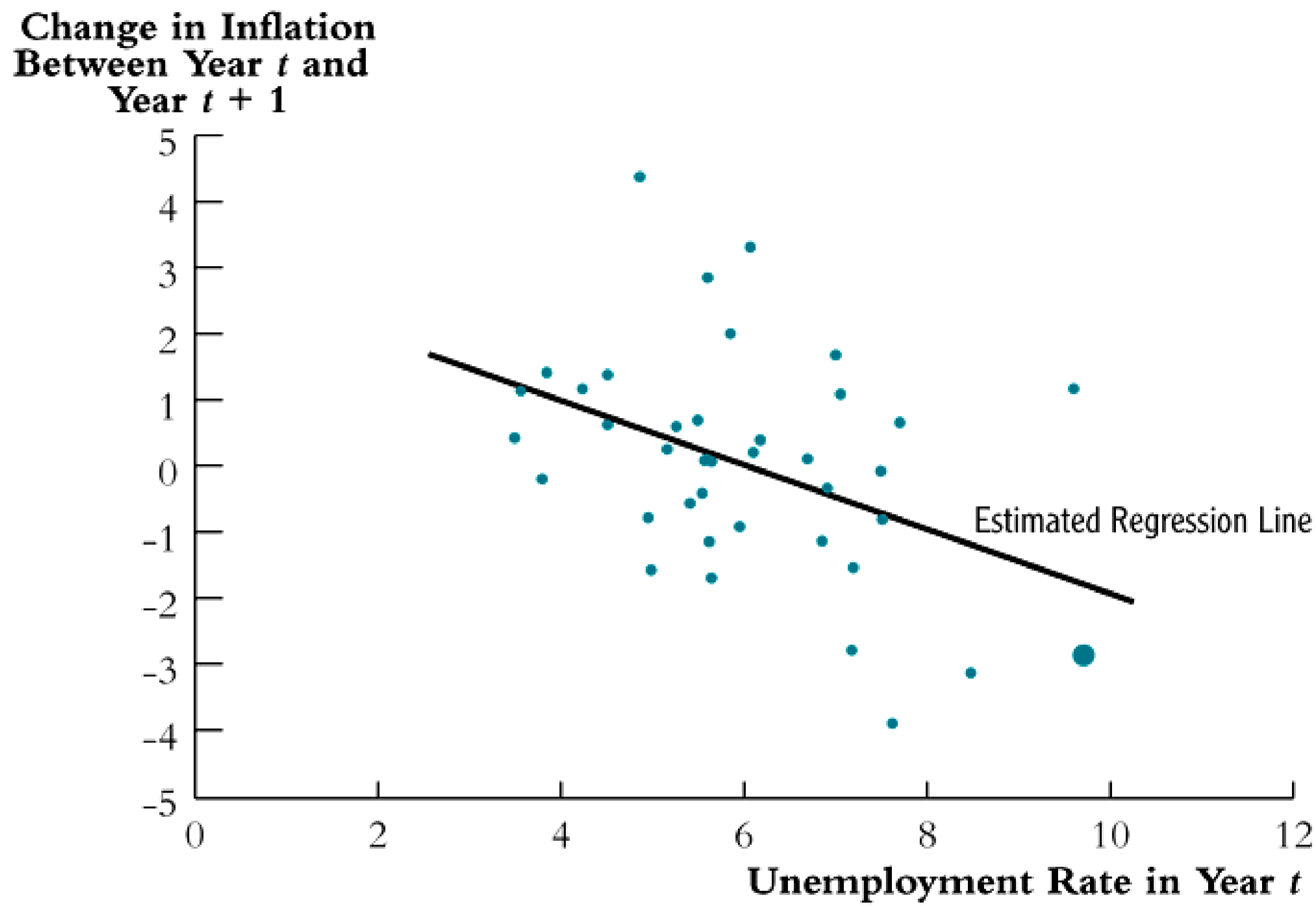
Example: lagged unemployment and inflation

- According to the "Phillips curve" says that if unemployment is above its equilibrium, or "natural," rate, then the rate of inflation will increase.
- That is, ΔInf_t should be related to lagged values of the unemployment rate, with a negative coefficient
- The rate of unemployment at which inflation neither increases nor decreases is often called the "non-accelerating rate of inflation" unemployment rate: the NAIRU
- Is this relation found in US economic data?
  Can this relation be exploited for forecasting inflation?

The empirical "Phillips Curve"

FIGURE 12.3 **Scatterplot of Change in Inflation Between Year *t* and Year *t* + 1 vs. the Unemployment Rate in Year *t***

In 1982, the U.S. unemployment rate was 9.7% and the rate of inflation in 1983 fell by 2.9% (the large dot). In general, high values of the unemployment rate in year *t* tend to be followed by decreases in the rate of price inflation in the next year, year *t* + 1, with a correlation of –0.40.



Example: d.inf and unem – STATA

```
. reg d.inf L(1/4).d.inf L(1/4).unem if tin(1962q1,1999q4), r;

Regression with robust standard errors                 Number of obs =     152
                                                       F(  8,   143) =    7.99
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.3802
                                                       Root MSE      =   1.371

------------------------------------------------------------------------------
             |               Robust
D.inf        |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
inf          |
         L1D. |  -.3629871   .0926338    -3.92   0.000    -.5460956   -.1798786
         L2D. |  -.3432017    .100821    -3.40   0.001    -.5424937   -.1439096
         L3D. |   .0724654   .0848729     0.85   0.395    -.0953022     .240233
         L4D. |  -.0346026   .0868321    -0.40   0.691    -.2062428    .1370377
unem         |
           L1 |  -2.683394   .4723554    -5.68   0.000    -3.617095   -1.749692
           L2 |   3.432282    .889191     3.86   0.000     1.674625    5.189939
           L3 |  -1.039755   .8901759    -1.17   0.245    -2.799358     .719849
           L4 |   .0720316   .4420668     0.16   0.871    -.8017984    .9458615
_cons        |   1.317834   .4704011     2.80   0.006     .3879961    2.247672
------------------------------------------------------------------------------
```

Example: ADL(4,4) model of inflation – STATA, ctd.

```
.  dis "Adjusted Rsquared = " _result(8);
Adjusted Rsquared = .34548812

.  test L2D.inf L3D.inf L4D.inf;

 ( 1)  L2D.inf = 0.0
 ( 2)  L3D.inf = 0.0
 ( 3)  L4D.inf = 0.0

       F(  3,   143) =    4.93           The extra lags of d.inf are signif.
            Prob > F =    0.0028

.  test L1.unem L2.unem L3.unem L4.unem;

 ( 1)  L.unem = 0.0
 ( 2)  L2.unem = 0.0
 ( 3)  L3.unem = 0.0
 ( 4)  L4.unem = 0.0

       F(  4,   143) =    8.51           The lags of unem are significant
            Prob > F =    0.0000
```

The null hypothesis that the coefficients on the lags of the unemployment rate are all zero is rejected at the 1% significance level using the F-statistic