Macroeconomic Analysis

Introduction to business cycle analysis

Stylized facts of business cycles

Main features of business *fluctuations* defined as

> recurrent periods of expansion and contraction ("recessions") in the aggregate economic activity

A *recession* is broadly defined (NBER 2003) as

> 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. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough. Between trough and peak the economy is in an expansion. Expansion is the normal state of the economy; most recessions are brief and they have been rare in recent decades

The **"official" dating** of expansions and recessions in the US provided by the NBER is based on the above definition, which refers to the overall level of economic time series with no reference to deviations from a long-term growth trend.

NATIONAL BUREAU OF ECONOMIC RESEARCH

US Business Cycle Expansions and Contractions [1]

pdf version

Contractions (recessions) start at the peak of a business cycle and end at the trough.

Please also see:

Latest announcement from the NBER's Business Cycle Dating Committee, dated 9/20/10.

Press citations on NBER Business Cycles

BUSINESS CYCLE REFERENCE DATES		DURATION IN MONTHS			
Peak	**Trough**	**Contraction**	**Expansion**	**Cycle**	
Quarterly dates are in parentheses		*Peak to Trough*	*Previous trough to this peak*	*Trough from Previous Trough*	*Peak from Previous Peak*
	December 1854 (IV)	--	--	--	--
June 1857(II)	December 1858 (IV)	18	30	48	--
October 1860(III)	June 1861 (III)	8	22	30	40
April 1865(I)	December 1867 (I)	32	46	78	54
June 1869(II)	December 1870 (IV)	18	18	36	50
October 1873(III)	March 1879 (I)	65	34	99	52
March 1882(I)	May 1885 (II)	38	36	74	101
March 1887(II)	April 1888 (I)	13	22	35	60
July 1890(III)	May 1891 (II)	10	27	37	40
January 1893(I)	June 1894 (II)	17	20	37	30
December 1895(IV)	June 1897 (II)	18	18	36	35
June 1899(III)	December 1900 (IV)	18	24	42	42
September 1902(IV)	August 1904 (III)	23	21	44	39
May 1907(II)	June 1908 (II)	13	33	46	56
January 1910(I)	January 1912 (IV)	24	19	43	32
January 1913(I)	December 1914 (IV)	23	12	35	36
August 1918(III)	March 1919 (I)	7	44	51	67
January 1920(I)	July 1921 (III)	18	10	28	17
May 1923(II)	July 1924 (III)	14	22	36	40
October 1926(III)	November 1927 (IV)	13	27	40	41
August 1929(III)	March 1933 (I)	43	21	64	34
May 1937(II)	June 1938 (II)	13	50	63	93
February 1945(I)	October 1945 (IV)	8	80	88	93
November 1948(IV)	October 1949 (IV)	11	37	48	45
July 1953(II)	May 1954 (II)	10	45	55	56
August 1957(III)	April 1958 (II)	8	39	47	49
April 1960(II)	February 1961 (I)	10	24	34	32
December 1969(IV)	November 1970 (IV)	11	106	117	116
November 1973(IV)	March 1975 (I)	16	36	52	47
January 1980(I)	July 1980 (III)	6	58	64	74
July 1981(III)	November 1982 (IV)	16	12	28	18
July 1990(III)	March 1991(I)	8	92	100	108
March 2001(I)	November 2001 (IV)	8	120	128	128
December 2007 (IV)	June 2009 (II)	18	73	91	81
Average, all cycles:					
1854-2009 (33 cycles)		16	42	56	55*
1854-1919 (16 cycles)		22	27	48	49**
1919-1945 (6 cycles)		18	35	53	53
1945-2009 (11 cycles)		11	59	73	66

* 32 cycles

** 15 cycles

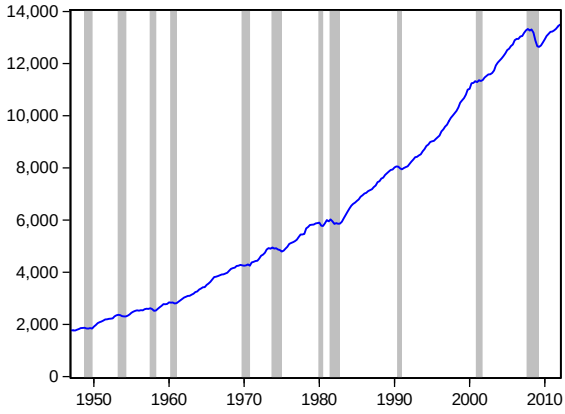
Source: NBER

The determination that the last expansion began in June 2009 is the most recent decision of the Business Cycle Dating Committee of the National Bureau of Economic Research.

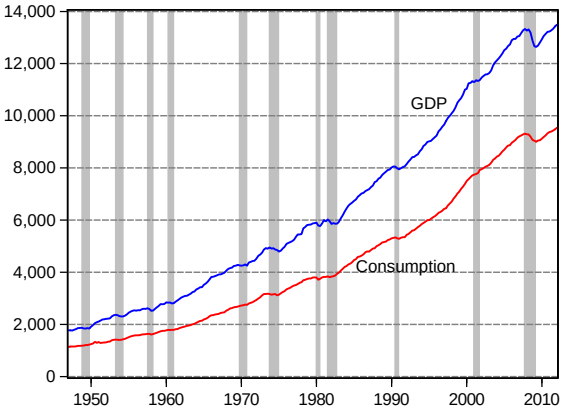
Announcement dates:

The June 2009 trough was announced September 20, 2010.
The December 2007 peak was announced December 1, 2008.
The November 2001 trough was announced July 17, 2003.
The March 2001 peak was announced November 26, 2001.
The March 1991 trough was announced December 22, 1992.

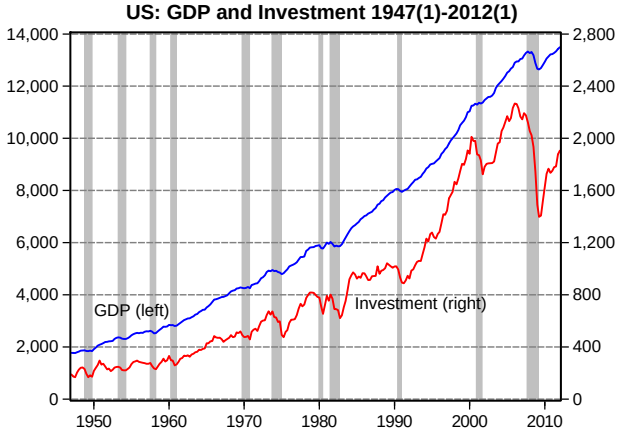
US: GDP 1947(1)-2012(1) with NBER recessions



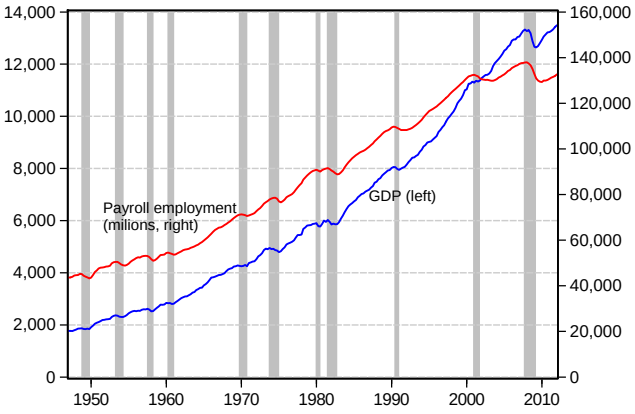
US: GDP and Consumption 1947(1)-2012(1)



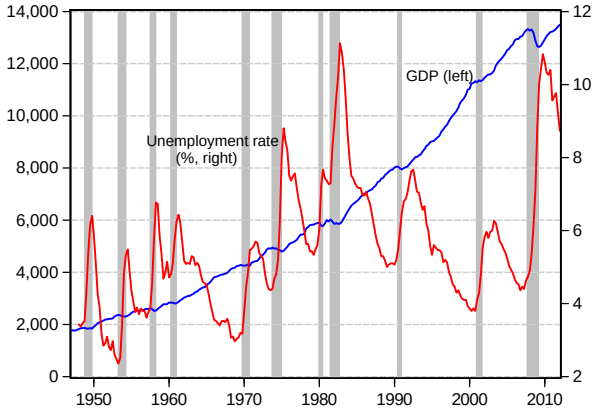
US: GDP and Investment 1947(1)-2012(1)



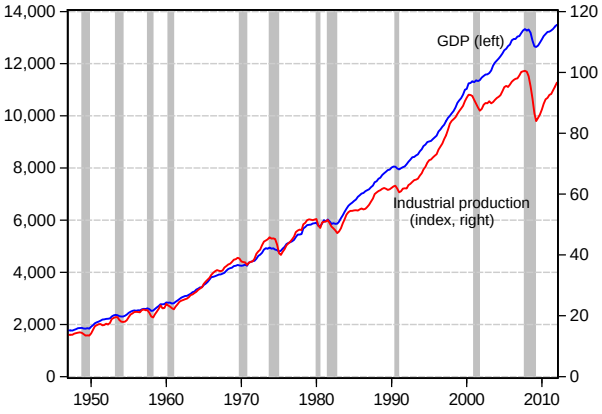
US: GDP and Payroll employment 1947(1)-2012(1)



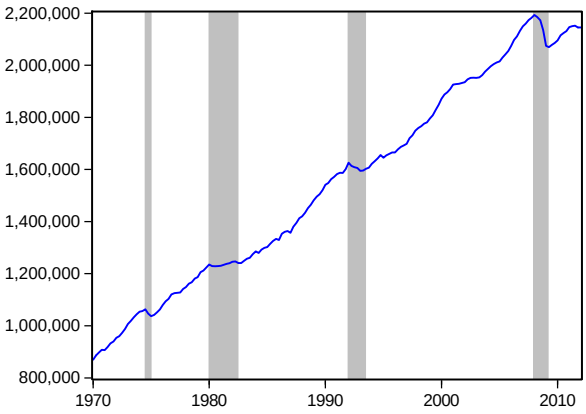
US: GDP and Unemployment rate 1948(1)-2012(1)



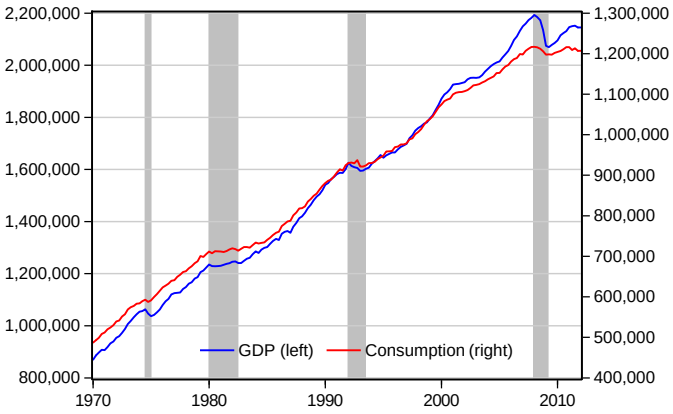
US: GDP and Industrial production 1947(1)-2012(1)



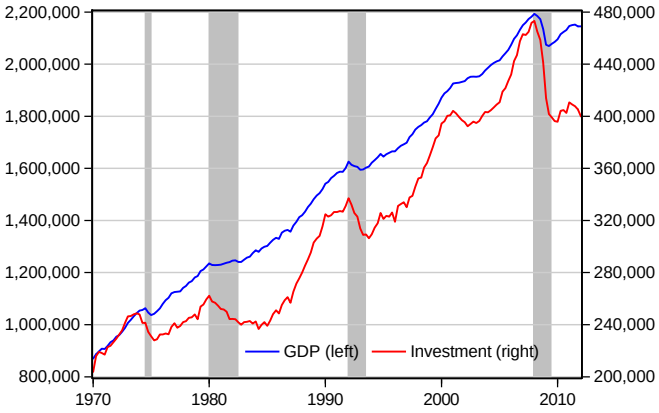
Euro Area: GDP 1970(1)-2012(1) with CEPR recessions



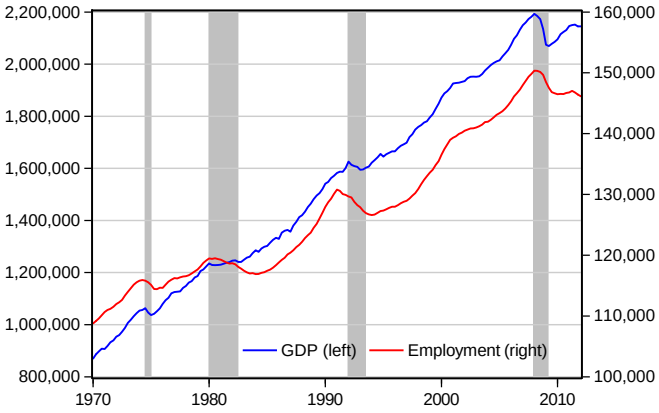
Euro Area: GDP and Private Consumption 1970(1)-2012(1)



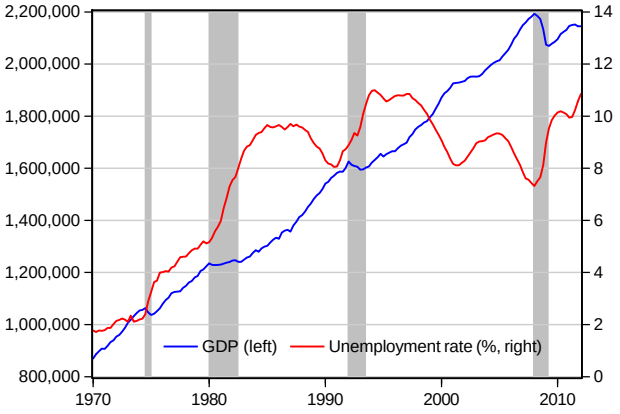
Euro Area: GDP and Investment 1970(1)-2012(1)



Euro Area: GDP and Employment 1970(1)-2012(1)



Euro Area: GDP and Unemployment rate 1970(1)-2012(1)



The **approach of modern studies** of business cycle properties views business cycle facts as the *statistical properties* of the *deviations from a long-term growth trend* of a large set of macroeconomic aggregates, including output (GDP), its main components (consumption, investment), employment, labor productivity, real wages, the inflation rate. The implementation of this approach requires a method for decomposing a series into a trend and a cyclical component.

Trend and cycle determination. To distinguish between the *trend* and the *cyclical* components of time series various "filtering" techniques are used. One widely used technique is based on the *Hodrick-Prescott (HP) filter* [from Hodrick R.J. and E.C. Prescott (1997) "Postwar US business cycles: an empirical investigation", *Journal of money,credit and banking*, 29, 1]

In general, given a series y_t:

$$y_t = \underset{\text{TREND}}{y_t^{TR}} + \underset{\text{CYCLE}}{y_t^{C}} \qquad t = 1, ..., T$$

the trend component can be obtained for each time date t by applying a *two-sided linear filter* (i.e. applying a set of weights a_i to all -past, present, and future- values of the series):

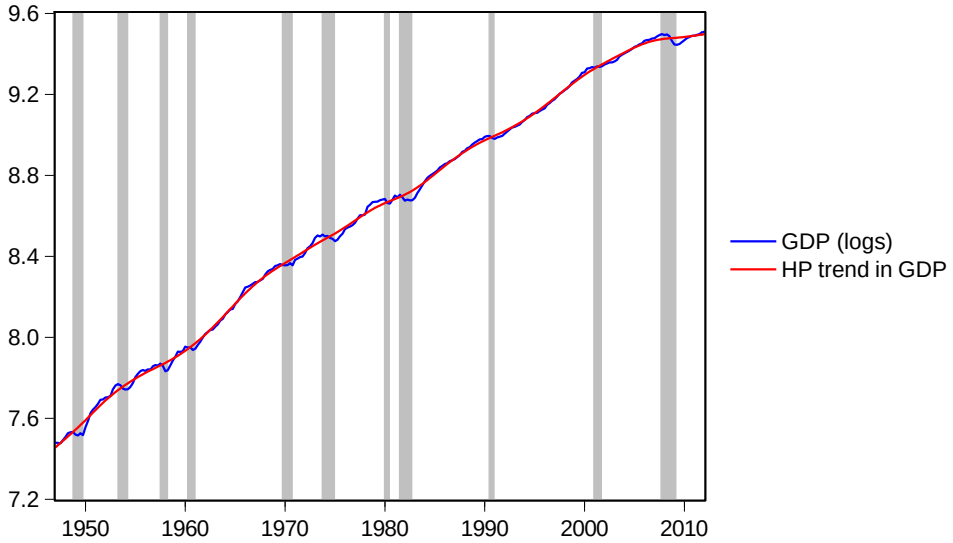
$$y_t^{TR} = \sum_{i=-\infty}^{i=\infty} a_i \, y_{t-i}$$

(if the weights are applied only to past and present values of the series, i.e. a_i is defines only for $i = 0, ...\infty$, the filter is called *one-sided*).
The Hodrick-Prescott filter is based on the underlying assumption (suggested by neoclassical growth theory) that the trend component of aggregate economic time series varies smoothly over time. Operationally, trend values y_t^{TR} are obtained from the solution of the following minimization problem:

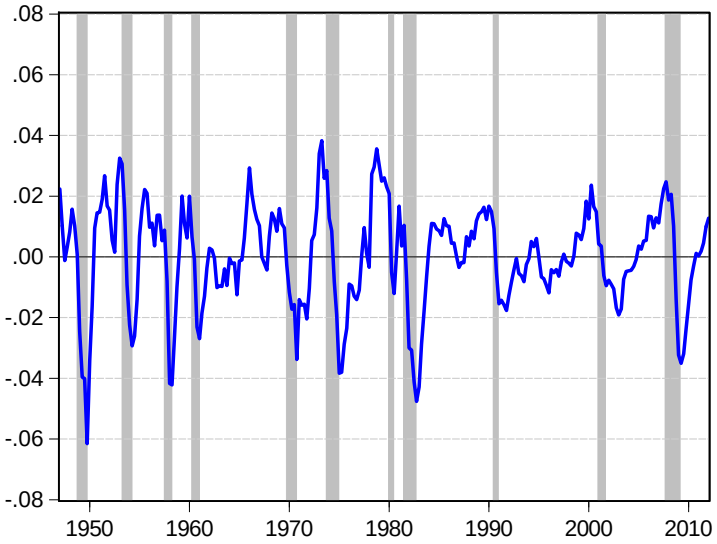
$$\min_{\left\{y_t^{TR}\right\}} \sum_{t=1}^{T} \left\{ \left(y_t - y_t^{TR}\right)^2 + \lambda \left[\left(y_t^{TR} - y_{t-1}^{TR}\right) - \left(y_{t-1}^{TR} - y_{t-2}^{TR}\right) \right]^2 \right\}$$

where the "smoothing"parameter $\lambda \geq 0$ captures the relative weight in the objective function of changes in the trend over time and penalizes variations in the growth rate of the trend component. If $\lambda \to 0$ then $y_t^{TR} \to y_t$ (no cycle), whereas if$\lambda \to \infty$ then y_t^{TR} tends to a simple linear trend. Conventionally, a value of $\lambda = 1600$ is used for quarterly data.

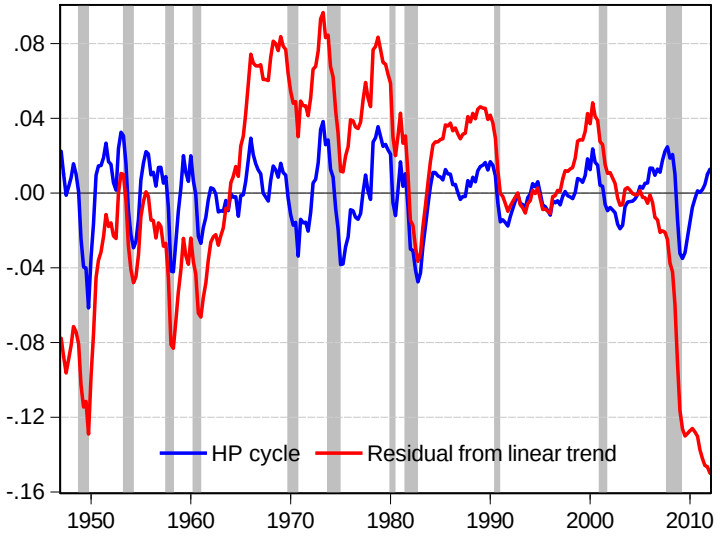
US: GDP 1947-2012 and Hodrick-Prescott trend with NBER recessions



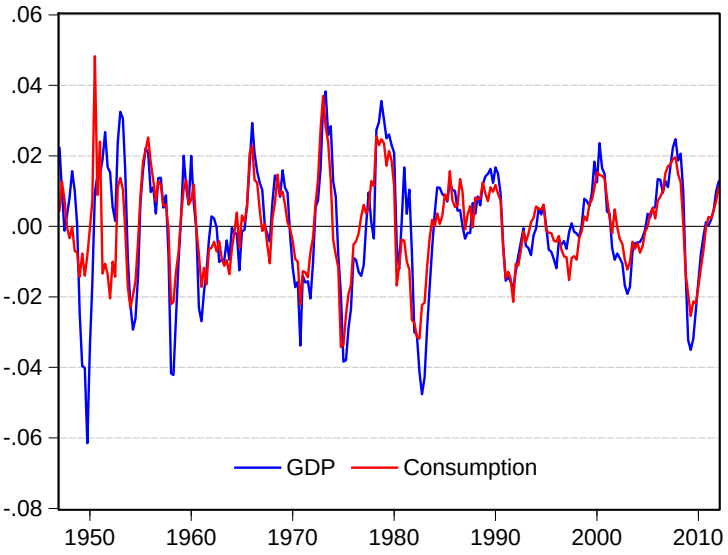
US: Hodrick-Prescott cyclical component 1947-2012 with NBER recessions



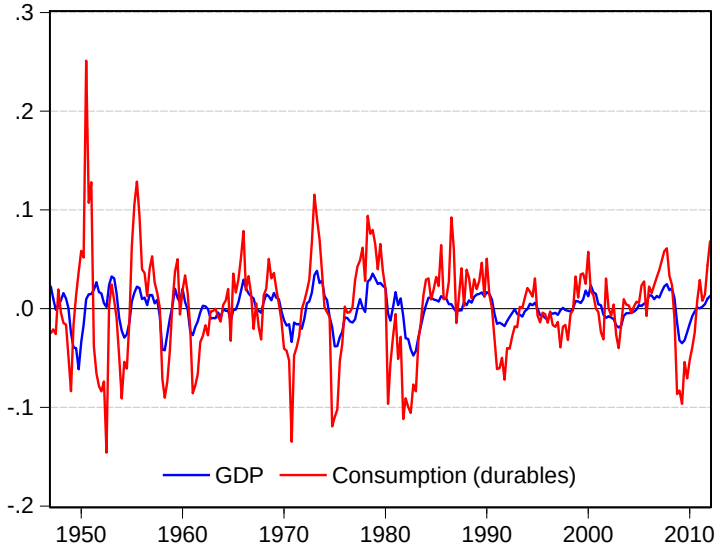
US: HP cyclical component and linear trend residual 1947-2012 with NBER recessions



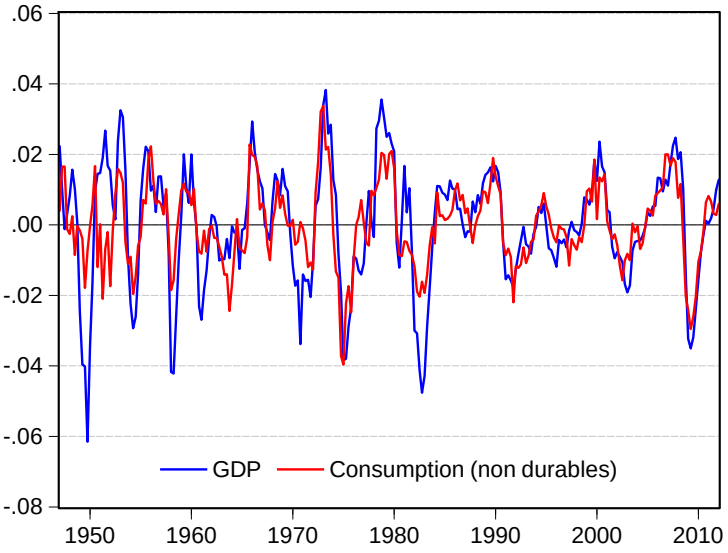
US: Cyclical components in GDP and Consumption (HP filter)



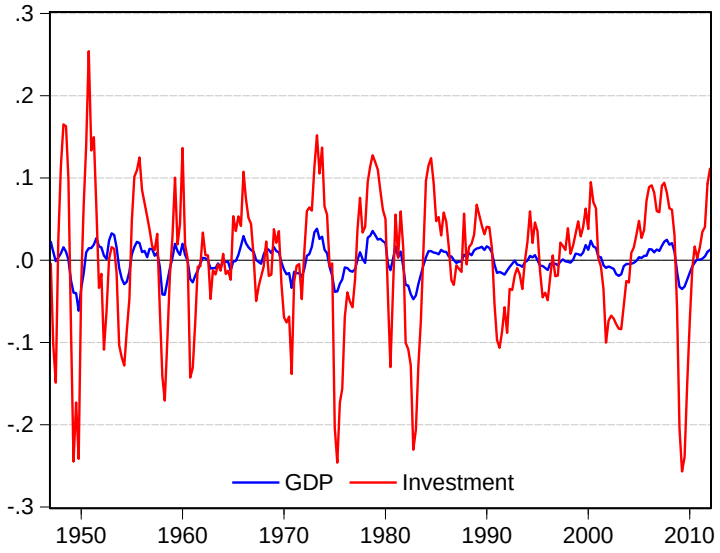
US: Cyclical components in GDP and Consumption (durables)

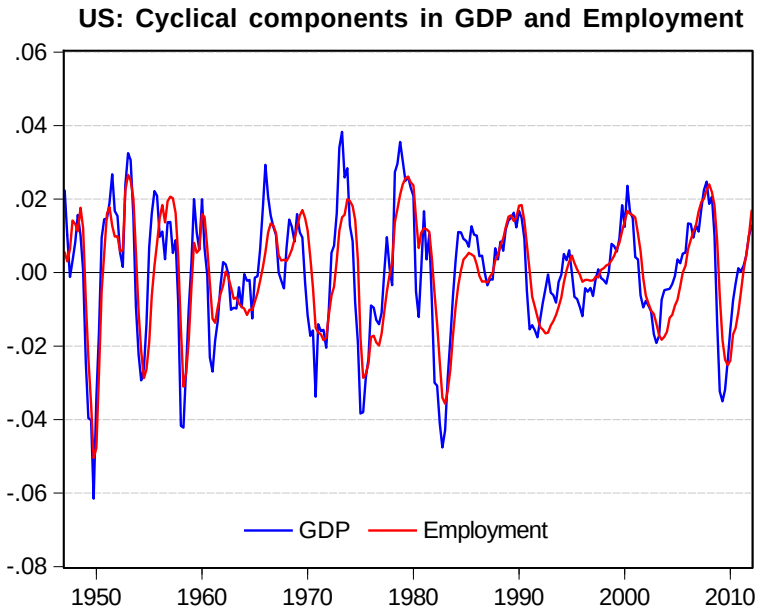


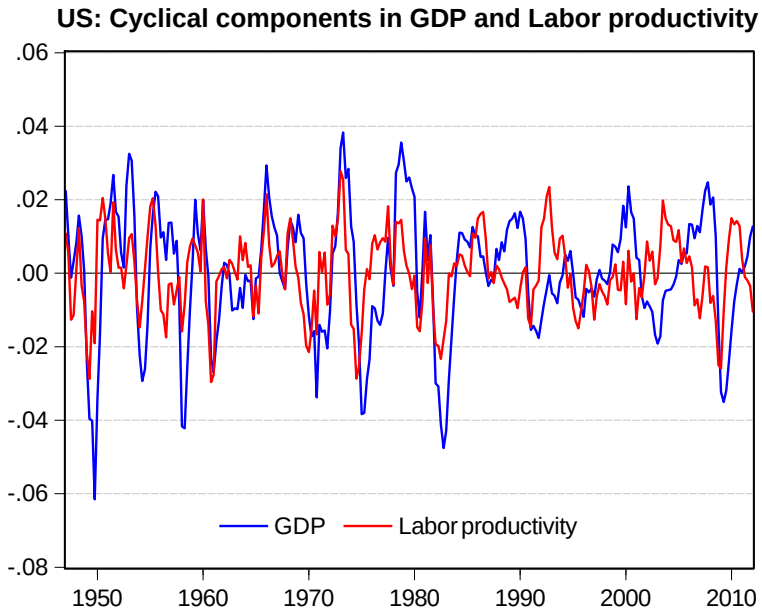
US: Cyclical components in GDP and Consumption (non dur.)

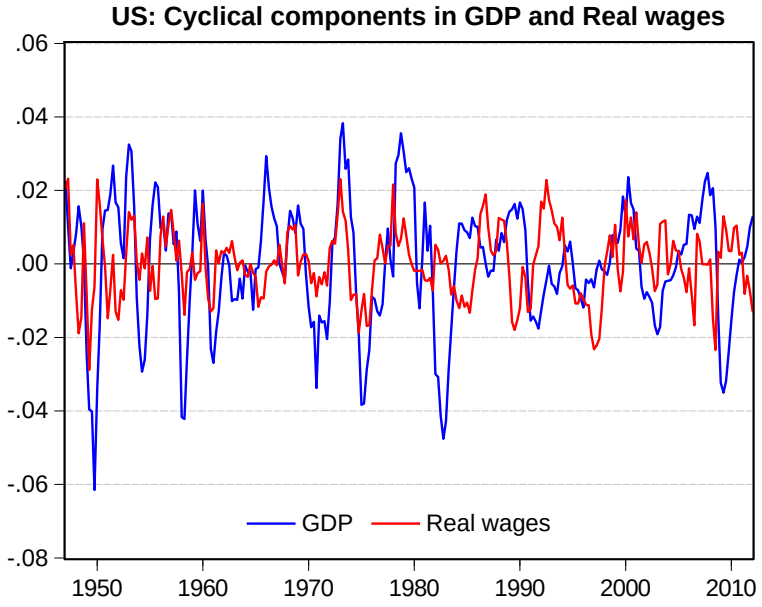


US: Cyclical components in GDP and Investment

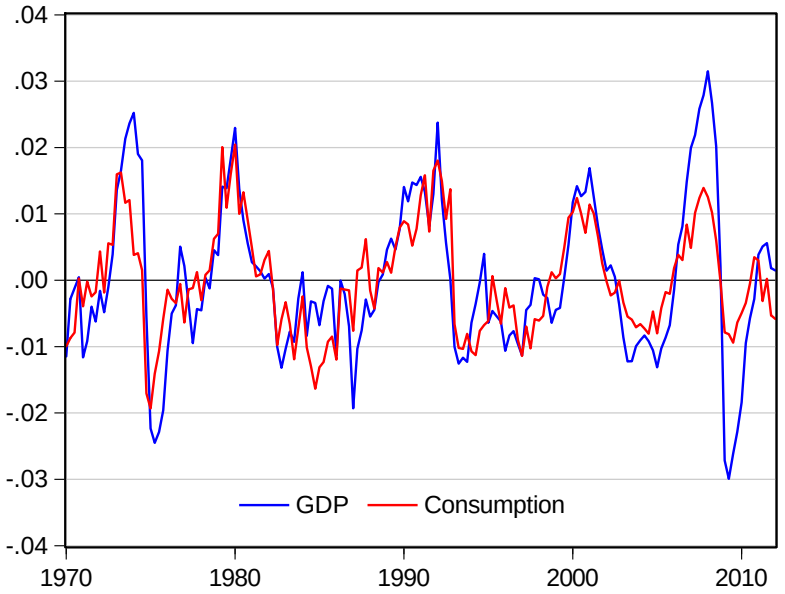



US: Cyclical components in GDP and Employment
.06
.04
.02
.00
-.02
-.04
-.06
-.08
1950
1960
1970
1980
1990
2000
2010
GDP
Employment

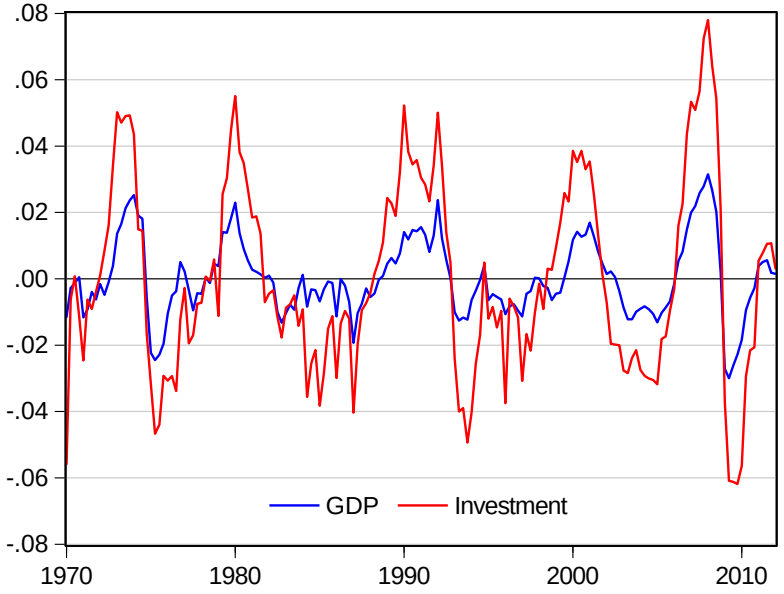

US: Cyclical components in GDP and Labor productivity
.06
.04
.02
.00
-.02
-.04
-.06
-.08
1950
1960
1970
1980
1990
2000
2010
GDP
Labor productivity


US: Cyclical components in GDP and Real wages
.06
.04
.02
.00
-.02
-.04
-.06
-.08
1950
1960
1970
1980
1990
2000
2010
GDP
Real wages

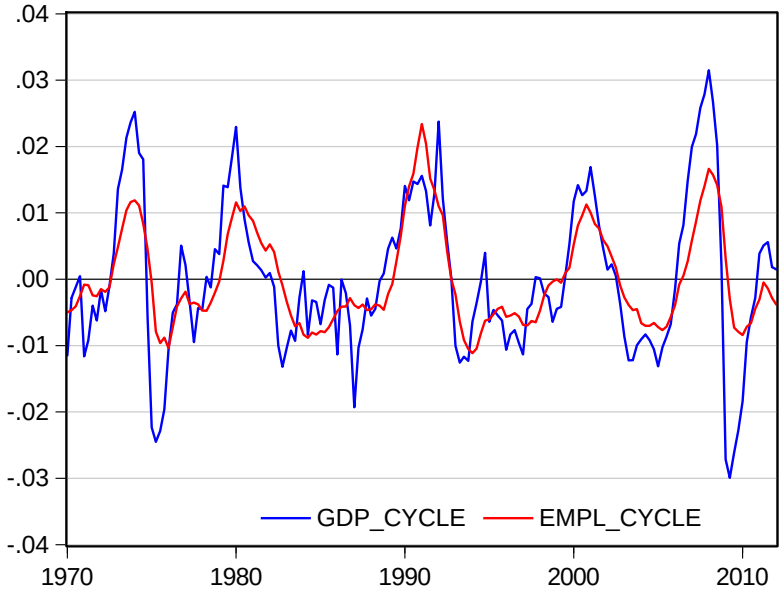
Euro Area: Cyclical components in GDP and Consumption (HP filter)



Euro Area: Cyclical components in GDP and Investment



Euro Area: Cyclical components in GDP and Employment



Main business cycle "stylized facts" (USA 1947-2012)

- ***comovements***:

  (a) the main components of aggregate demand are strongly *procyclical* (their cyclical components show a large contemporaneous correlation with the cyclical component of GDP): *consumption* (durable and non-durable goods), *investiment*

  (b) *employment* is strongly *procyclical*, as well as *labor productivity* (though less strongly)

  (c) *real wages* do *not* show a strong cyclical pattern

  (d) the *inflation rate* and output move mainly in the same direction *in the short run*

- ***persistence:***

  high autocorrelation of the cyclical component of most aggregate series (around 0.8/0.9 at a one-quarter lag)

- ***volatility:***

  (a) *consumption* of *non durables* is *less* volatile than GDP whereas consumption of *durables* is *more*

  (b) *investment* is much *more* volatile than output

  (c) volatility of *employment* is close to that of GDP

  (d) *real wages* show *lower* volatility than GDP

Business cycle statistics:

US 1947(1)-2012(1)

	St. dev. (%)	Rel. st. dev.	Autoc(1).	Corr. with GDP
GDP	1.69	1	0.84	1
Cons.	1.30	0.77	0.81	0.78
dur.	4.99	2.95	0.73	0.63
non dur.	1.16	0.69	0.79	0.73
Invest.	8.29	4.91	0.79	0.85
Empl.	1.46	0.86	0.91	0.82
Lab. prod.	1.08	0.64	0.69	0.43
Real wage	0.96	0.57	0.65	0.15

Note: The table shows descriptive statistics for the *cyclical* components of the listed series obtained from the application of the Hodrick-Prescott filter to quarterly data (after taking logarithms). The first column shows the standard deviation of the cyclical components is expressed in percentage points; in the second column the standard deviations are reported relative to the st. dev. of GDP. The first-order autocorrelation coefficient is shown in the third column. The last column reports the contemporaneous (i.e. within the same quarter) correlation coefficients of each series with GDP.

Euro Area 1970(1)-2012(1)

	St. dev. (%)	Rel. st. dev.	Autoc(1).	Corr. with GDP
GDP	1.17	1	0.87	1
Cons.	0.82	0.70	0.83	0.79
Invest.	2.92	2.50	0.88	0.92
Empl.	0.74	0.63	0.95	0.78

Note: See Note for the US