

# Homework 2

Eco 4306 Economic and Business Forecasting

Spring 2019

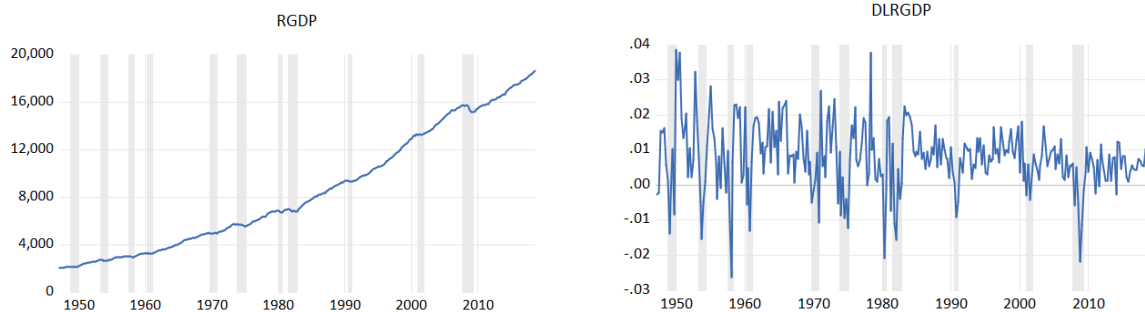
Due: Wednesday, February 13, before the class

## Problem 1 (70 points)

Visit again the website of the Federal Reserve Bank in St. Louis (<http://research.stlouisfed.org>) and download the following data:

(a) (10 points) U.S. real GDP., time series **GDPC1**:

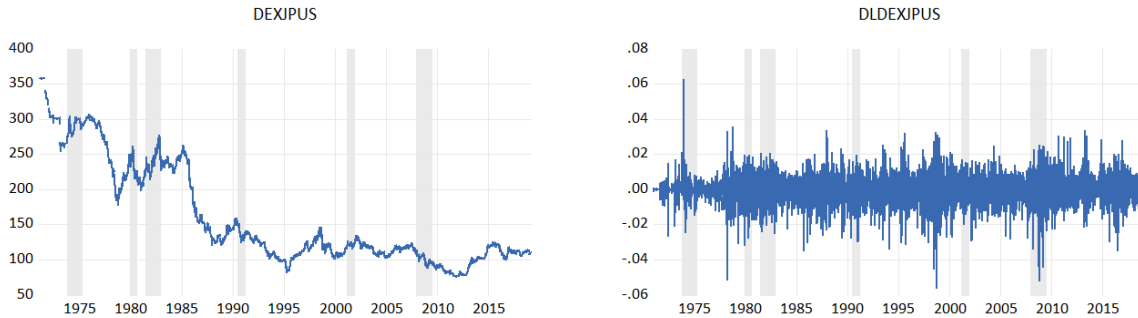
- definition: real gross domestic product is the inflation adjusted value of the goods and services produced by labor and property located in the United States
- units: billions of chained 2009 dollars, seasonally adjusted annual rate
- frequency: quarterly



Time series is not weakly stationary, because it is growing over time, so mean and variance can not be constant. To obtain weakly stationary data we transform the time series by taking log and then calculating the first differences. The resulting series approximates the growth rate (percentage change) and fluctuates around mean with roughly same volatility over the sample period.

(b) (10 points) The exchange rate of the Japanese yen against the U.S. dollar., time series **DEXJPUS**:

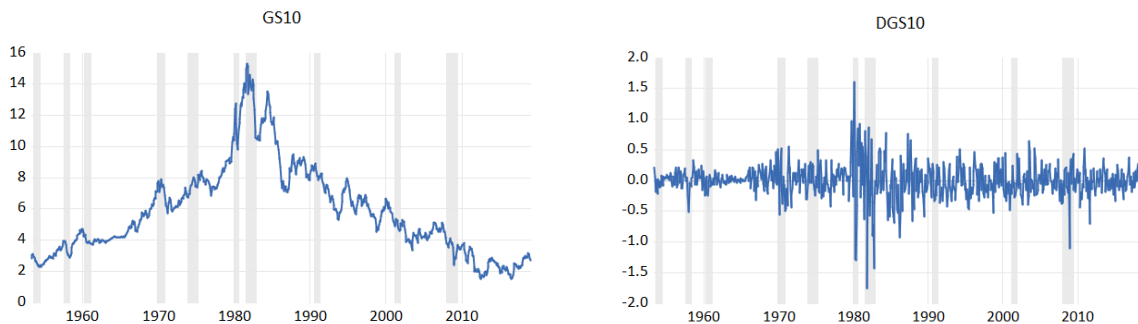
- definition: Noon buying rates in New York City for cable transfers payable in foreign currencies.
- units: Japanese yen to one U.S. dollar, not seasonally adjusted
- frequency: daily



Time series might be weakly stationary, if we only consider the period since 1990, but before that it was gradually declining in 1970s and 1980s. To obtain weakly stationary data we transform the time series by taking log and then calculating the first differences. The resulting series approximates the growth rate (percentage change) and fluctuates around its mean, though the volatility appears to be changing, with calmer periods interrupted by period of larger volatility.

(c) (10 points) The 10-year U.S. Treasury constant maturity yield., time series **GS10**:

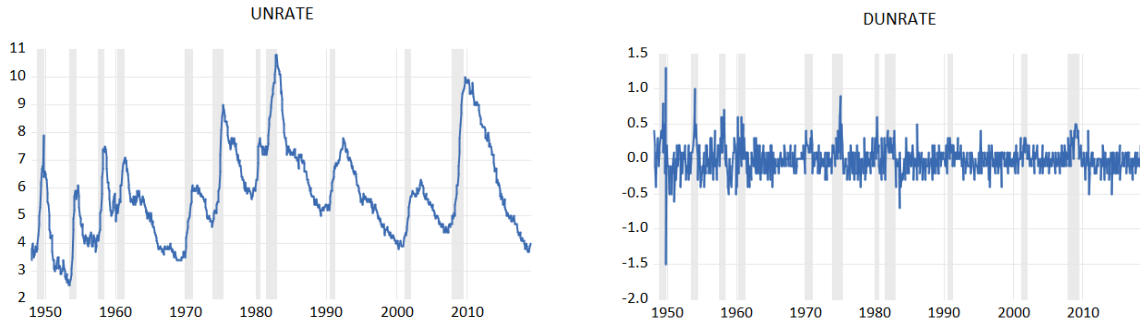
- definition:
- units: percent, not seasonally adjusted
- frequency: monthly



Time series was gradually growing in 1960s and 1970s, but was since then gradually declining, so it is hard to tell whether it is weakly stationary or not. The first difference appears first order weakly stationary but not second order weakly stationary, since its volatility is changing over time.

(d) (10 points) The U.S. unemployment rate., time series **UNRATE**:

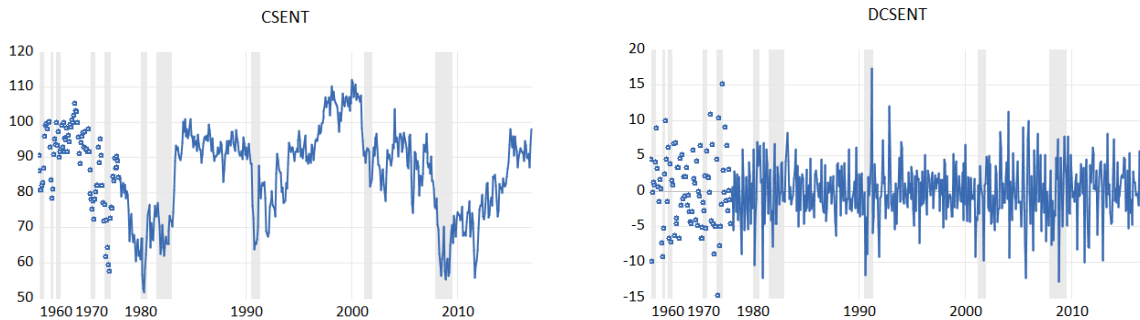
- definition: Number of unemployed as a percentage of the labor force. Labor force data are restricted to people 16 years of age and older, who do not reside in institutions (e.g., penal and mental facilities, homes for the aged), and who are not on active duty in the Armed Forces.
- units: percent, seasonally adjusted
- frequency: monthly



Time series might be weakly stationary, since it is not growing and instead it fluctuates around its mean, but it shows a lot of persistence. The time series for first differences also fluctuates around its mean, with roughly constant volatility, and with much smaller persistence.

(e) (10 points) Index of Consumer Sentiment:, time series **UMICH/SOC1**

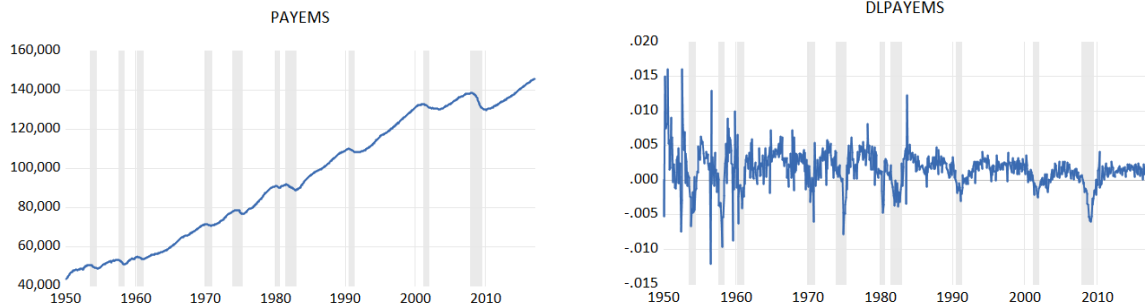
- definition:
- units: index, 1966Q1=100, not seasonally adjusted
- frequency:



Time series appears to be weakly stationary, since it fluctuates around its mean, but this time series also shows high persistence. The time series for first differences also fluctuates around its mean, with roughly constant volatility, and with much smaller persistence.

(f) (10 points) All Employees, Total Nonfarm Payrolls, time series **PAYEMS**

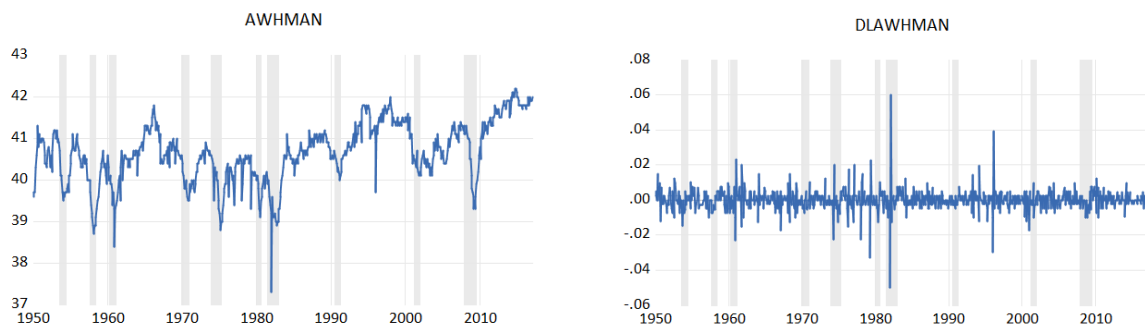
- definition: Total Nonfarm Payroll, is a measure of the number of U.S. workers in the economy that excludes proprietors, private household employees, unpaid volunteers, farm employees, and the unincorporated self-employed. This measure accounts for approximately 80 percent of the workers who contribute to Gross Domestic Product (GDP).
- units: thousands of persons, seasonally adjusted
- frequency: monthly



Time series is not weakly stationary, because it is growing over time, so mean and variance can not be constant. To obtain weakly stationary data we transform the time series by taking log and then calculating the first differences. The resulting series approximates the growth rate (percentage change) and fluctuates around mean with roughly same volatility over the sample period.

(g) (10 points) Average Weekly Hours of Production and Nonsupervisory Employees: Manufacturing; time series **AWHMAN**

- definition: Average weekly hours are the total weekly hours divided by the employees paid for those hours. Nonsupervisory employees include individuals who are not above the working-supervisor level.
- units: hours, seasonally adjusted
- frequency: monthly



Time series appears to be weakly stationary, since it fluctuates around its mean. The time series for first differences also fluctuates around its mean.

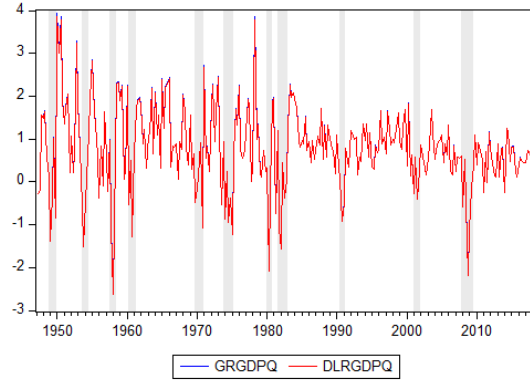
## Problem 2 (30 points)

- (a) (10 points) There is almost no noticeable difference between the the quarter-over-quarter growth rate (percentage change) of the real GDP

$$grGDPQ_t = 100 \times \frac{Y_t - Y_{t-1}}{Y_{t-1}}$$

and the first log-differences of the real GDP

$$dlrGDPQ_t = 100 \times (y_t - y_{t-1}) = 100 \times (\log Y_t - \log Y_{t-1})$$

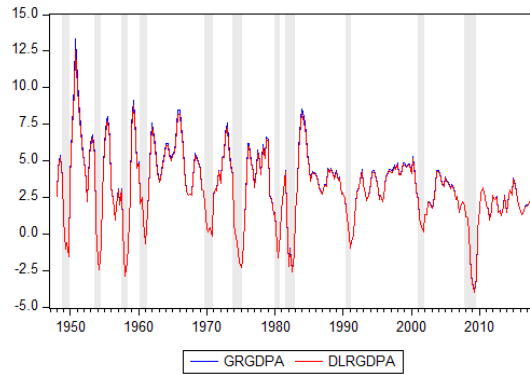


- (b) (10 points) There is almost no noticeable difference between the year-over-year growth rate (percentage change) of the real GDP

$$grGDPA_t = 100 \times \frac{Y_t - Y_{t-4}}{Y_{t-4}}$$

and the first log-differences at lag 4 of the real GDP

$$dlrGDPA_t = 100 \times (y_t - y_{t-4}) = 100 \times (\log Y_t - \log Y_{t-4})$$



- (c) (10 points) The ACF and PACF for  $dlrGDPA_t$  show that there is more linear dependence (higher autocorrelation coefficients) than in  $dlrGDPQ_t$ . The AC coefficients are statistically different from zero for first two lags in case of  $dlrGDPQ_t$  and for first three lags in case of  $dlrGDPA_t$ .

Date: 02/12/19 Time: 18:54 Time Series: DLRGDPQ  
Sample: 1947Q1 2018Q3  
Included observations: 286

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
		1 0.360	0.360	37.451	0.000
		2 0.227	0.112	52.384	0.000
		3 0.019	-0.110	52.486	0.000
		4 -0.059	-0.069	53.499	0.000
		5 -0.126	-0.077	58.124	0.000
		6 -0.032	0.067	58.422	0.000
		7 -0.042	-0.021	58.942	0.000
		8 -0.013	-0.017	58.991	0.000
		9 0.079	0.099	60.862	0.000
		10 0.095	0.043	63.568	0.000
		11 0.020	-0.066	63.682	0.000
		12 -0.112	-0.156	67.433	0.000
		13 -0.114	-0.019	71.349	0.000
		14 -0.055	0.084	72.258	0.000
		15 -0.078	-0.064	74.114	0.000
		16 0.054	0.078	74.998	0.000
		17 0.052	0.012	75.826	0.000
		18 0.106	0.064	79.248	0.000
		19 0.067	-0.015	80.647	0.000
		20 0.071	-0.006	82.209	0.000
		21 -0.068	-0.072	83.641	0.000
		22 -0.048	0.030	84.371	0.000
		23 -0.093	-0.036	87.102	0.000
		24 -0.015	0.031	87.173	0.000
		25 0.035	0.047	87.554	0.000
		26 0.026	-0.037	87.770	0.000
		27 0.064	0.027	89.054	0.000
		28 0.084	0.053	91.320	0.000
		29 0.042	-0.003	91.879	0.000
		30 -0.097	-0.145	94.927	0.000
		31 -0.055	0.051	95.898	0.000
		32 -0.053	0.051	96.818	0.000
		33 0.020	0.050	96.951	0.000
		34 0.072	0.008	98.647	0.000
		35 0.045	-0.050	99.314	0.000
		36 0.025	-0.004	99.517	0.000

Date: 02/12/19 Time: 18:54 Time Series: DLRGDPA  
Sample: 1947Q1 2018Q3  
Included observations: 283

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
		1 0.851	0.851	207.24	0.000
		2 0.587	-0.498	306.29	0.000
		3 0.288	-0.181	330.13	0.000
		4 0.025	-0.022	330.31	0.000
		5 -0.085	0.366	332.41	0.000
		6 -0.100	-0.130	335.35	0.000
		7 -0.059	-0.079	336.37	0.000
		8 0.002	-0.018	336.37	0.000
		9 0.046	0.150	337.00	0.000
		10 0.039	-0.200	337.45	0.000
		11 -0.005	-0.060	337.46	0.000
		12 -0.075	-0.043	339.12	0.000
		13 -0.111	0.292	342.77	0.000
		14 -0.101	-0.112	345.83	0.000
		15 -0.050	-0.009	346.57	0.000
		16 0.036	0.018	346.97	0.000
		17 0.103	0.129	350.16	0.000
		18 0.129	-0.156	355.21	0.000
		19 0.110	-0.027	358.94	0.000
		20 0.051	-0.016	359.75	0.000
		21 -0.019	0.131	359.86	0.000
		22 -0.058	-0.026	360.90	0.000
		23 -0.068	-0.070	362.32	0.000
		24 -0.037	0.040	362.74	0.000
		25 0.016	0.103	362.83	0.000
		26 0.058	-0.052	363.87	0.000
		27 0.077	-0.107	365.72	0.000
		28 0.061	0.044	366.92	0.000
		29 0.016	0.041	367.00	0.000
		30 -0.033	0.004	367.35	0.000
		31 -0.045	0.067	368.00	0.000
		32 -0.029	-0.039	368.27	0.000
		33 0.013	-0.001	368.33	0.000
		34 0.049	-0.089	369.11	0.000
		35 0.043	-0.042	369.72	0.000
		36 0.006	-0.005	369.73	0.000