CHAPTER 3.

STATISTICS AND TIME SERIES

SOLUTIONS

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Exercise 1

a. Let $RPCE$ and $RDPI$ denote "real personal consumption expenditure" and "real disposable personal income" respectively. Their growth rates are calculated as follows,

$$\begin{aligned} G\_RPCE_t &= 100 \times [\log(RPCE_t) - \log(RPCE_{t-1})] \\ G\_RDPI_t &= 100 \times [\log(RDPI_t) - \log(RDPI_{t-1})]. \end{aligned}$$

Figure 1 and Figure 2 plot G_RPCE_t and G_RDPI_t respectively. From visual inspection of the graphs, we can see that the growth rate of consumption has a lower volatility when compared with the volatility of the growth rate of disposable income. G_RPCE fluctuates mainly within $\pm 2\%$, while G_RDPI within $\pm 4\%$. This phenomenon can be explained by *the permanent income hypothesis*, which argues that people, preferring a smooth path for consumption, will base their consumption on an average of their income over time rather than on their *current* income. Therefore, a large fluctuation in the current disposable income will only translate into a smaller fluctuation in consumption expenditure.

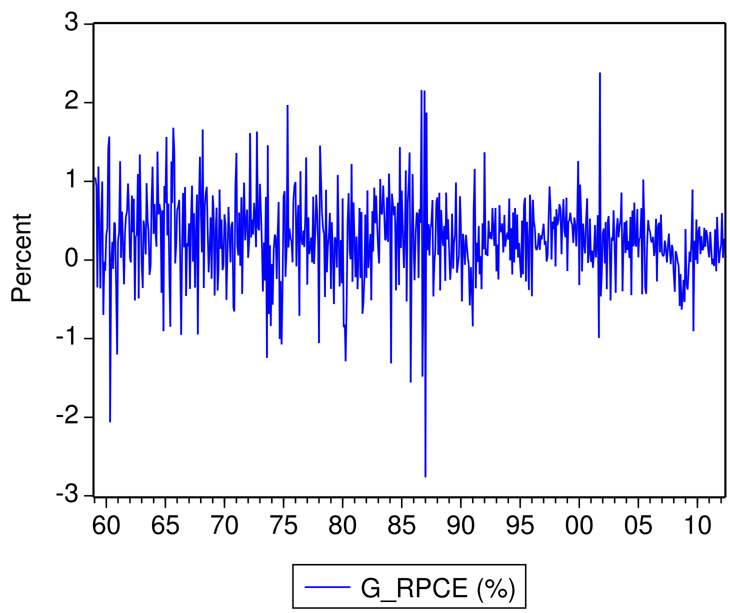


Figure 1: Time Series Plot of G_RPCE

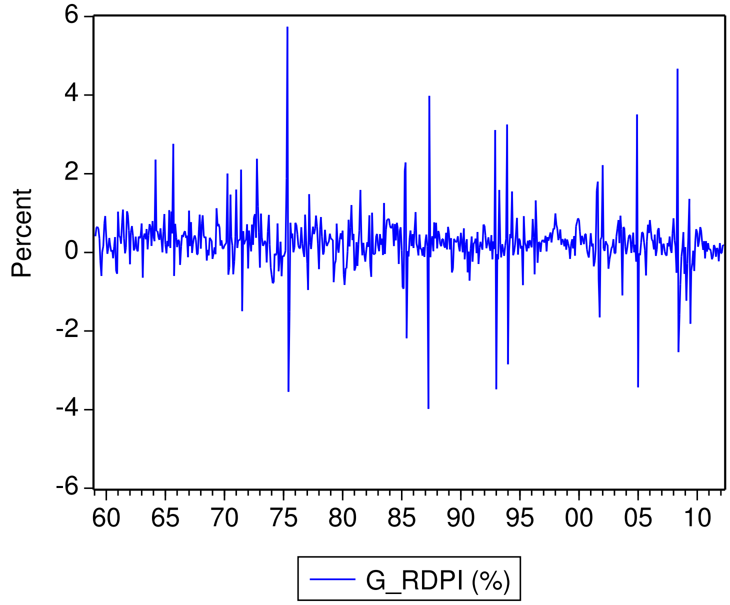


Figure 2: Time Series of G_RDPI

b. Estimate the following regression model in EViews,

$$G\_RPCE_t = \beta_0 + \beta_1 G\_RDPI_t + u_t.$$

Table 1 reports the estimation results. In the model, both estimates of the intercept and the coefficient of the growth rate of disposable income are statistically significant (their p-values are 0). The adjusted R-squared is approximately 0.052, meaning that about 5% of total sample variation of the dependent variable G_RPCE is explained by the independent variable G_RDPI. Observe that a very statistical regressor does not imply necessarily a great fit. The estimate $\hat{\beta}_1 = 0.17$ means that, on average, 1% monthly increase in the growth rate of real disposable income results in 0.17% increase in the growth rate of real personal consumption, giving some support for the permanent income hypothesis.

Dependent Variable: G_RPCE				
Method: Least Squares				
Sample (adjusted): 1959M02 2012M04				
Included observations: 639 after adjustments				
Newey-West HAC Standard Errors & Covariance (lag truncation=6)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.225422	0.020710	10.88443	0.0000
G_RDPI	0.174567	0.037659	4.635497	0.0000
R-squared	0.053117	Mean dependent var		0.271757
Adjusted R-squared	0.05163	S.D. dependent var		0.546044
S.E. of regression	0.531761	Akaike info criterion		1.57788
Sum squared resid	180.1243	Schwarz criterion		1.591839
Log likelihood	-502.133	F-statistic		35.73339
Durbin-Watson stat	2.377045	Prob(F-statistic)		0.000000

Table 1: Regression Results for Exercise 1b

c. Add a lag of the growth in disposable income to the equation estimated in b, and estimate the following regression model,

$$G\_RPCE_t = \beta_0 + \beta_1 G\_RDPI_t + \beta_2 G\_RDPI_{t-1} + u_t.$$

Table 2 reports the estimation results. The estimate of the coefficient of the newly added lagged term (G_RDPI_{t-1}) is statistically significant with p-value less than 0.18%. Therefore, there may be a response of consumption growth to changes in income growth over time: 1% increase in growth in disposable real income in the *last* period on average results in a 0.08% increase of growth in real personal consumption in the *current* period. If we add the impact effect (0.187) and the one-month lag effect (0.082), we have a total marginal effect on consumption growth of 0.27%, which is larger than that in Table 1.

The student may want to experiment with additional lags in the regression model and check whether there is statistical evidence for a one-to-one effect of income on consumption.

Dependent Variable: G_RPCE				
Method: Least Squares				
Sample (adjusted): 1959M03 2012M04				
Included observations: 638 after adjustments				
Newey-West HAC Standard Errors & Covariance (lag truncation=6)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.19887	0.02333	8.524343	0.0000
G_RDPI	0.187269	0.036346	5.152463	0.0000
G_RDPI(-1)	0.08286	0.026384	3.140473	0.0018
R-squared	0.064791	Mean dependent var		0.270540
Adjusted R-squared	0.061846	S.D. dependent var		0.545605
S.E. of regression	0.528464	Akaike info criterion		1.567006
Sum squared resid	177.339	Schwarz criterion		1.587970
Log likelihood	-496.875	F-statistic		21.99642
Durbin-Watson stat	2.409702	Prob(F-statistic)		0.000000

Table 2: Regression Results for Exercise 1c

Exercise 2

Let CPI denote the monthly Consumer Price Index. The monthly inflation rate $INFLRATE$ is,

$$INFLRATE_t = 100 \times [\log(CPI_t) - \log(CPI_{t-1})].$$

Let $NOMRATE\_ANN$ denote the 3-month T-bill interest rate downloaded from the FRED. Note that the interest rate is *annualized*, therefore, the corresponding monthly interest rate $NOMRATE$ should be,

$$NOMRATE_t = 100 \times \left[\left(1 + \frac{NOMRATE\_ANN_t}{100} \right)^{\frac{1}{12}} - 1 \right].$$

Then, the ex post monthly real interest rate $REALRATE$ is the difference between monthly nominal interest rate $NOMRATE_t$ and monthly inflation rate $INFLRATE_t$,

$$REALRATE_t = NOMRATE_t - INFLRATE_t.$$

Add the real interest rate to the regression model in Exercise 1b,

$$G\_RPCE_t = \beta_0 + \beta_1 G\_RDPI_t + \beta_2 REALRATE_t + u_t.$$

Table 3 reports the estimation results. The estimate of the coefficient of real interest rate, $\hat{\beta}_2 = 0.24$, is statistically significant with p-value around 1.9%, and it shows that 1% increase in real interest rate will on average increase the growth in real personal consumption by 0.24%. The economic interpretation for this result can be explained as follows. As real interest increases, the interest gains from people's investments will accrue faster. This will have both *substitution* and *wealth* effects. On one hand, higher interest rate means that the opportunity cost of consumption becomes higher, and people should consume less and invest more (substitution effect). On the other hand, higher interest rate also means that people's wealth increases and they will increase consumption accordingly (wealth effect). Since the estimate $\hat{\beta}_2$ is statistically significant and positive, we conclude that the wealth effect dominates.

The student may also augment the regression with lags of real disposable income and real interest rate along the lines of Exercise 1.

Dependent Variable: G_RPCE				
Method: Least Squares				
Sample (adjusted): 1959M02 2012M04				
Included observations: 639 after adjustments				
Newey-West HAC Standard Errors & Covariance (lag truncation=6)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.209677	0.019718	10.634	0.0000
G_RDPI	0.156575	0.038106	4.108891	0.0000
REALRATE	0.237827	0.100984	2.355103	0.0188
R-squared	0.067471	Mean dependent var		0.271757
Adjusted R-squared	0.064539	S.D. dependent var		0.546044
S.E. of regression	0.52813	Akaike info criterion		1.565734
Sum squared resid	177.3937	Schwarz criterion		1.586673
Log likelihood	-497.252	F-statistic		23.00817
Durbin-Watson stat	2.370345	Prob(F-statistic)		0.000000

Table 3: Regression Results for Exercise 2

Exercise 3
a. U.S. real GDP
Plot: Refer to Figure 3.
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.
Periodicity: Quarterly frequency, 1947Q1 - 2012Q1.
Units: Billions of chained 2005 dollars.
Stationary: Real GDP exhibits a clear upward trend with occasional local dips (recessions) and local peaks (expansions). Though we have plotted the numerical sample mean (blue line), this statistic is meaningless as this is not by any means a measure of centrality of the series. The underlying stochastic process is not first order stationary.

b. The exchange rate of the Japanese yen against U.S. dollar
Plot: Refer to Figure 4.
Definition: Japan/U.S. foreign exchange rate refers to noon buying rates (1 U.S. dollar) in New York City for cable transfers payable in foreign currencies (Japanese yen).
Periodicity: Daily frequency, 1971-01-04 to 2012-06-01.
Units: Japanese yen to one U.S. dollar.
Stationary: There is a downward trend in the series. Prior to 1977, the exchange rate was around 300; from the late 1970s to mid 80s, the rate fluctuated around 230; and thereafter, the Japanese

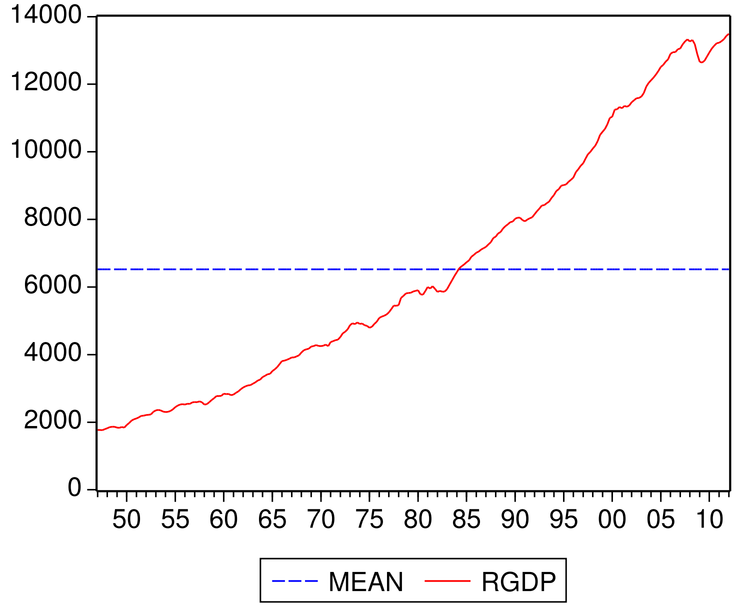


Figure 3: Time Series Plot of *RGDP*

yen kept appreciating to levels below 100. Once again, we plotted the sample mean value but with such a pronounced trend, there is no meaning for this average value. The process is not first order stationary.

c. The 10-year U.S. Treasury constant maturity yield
Plot: Refer to Figure 5.
Definition: Yields on actively traded non-inflation-indexed issues adjusted to constant maturities.
Periodicity: Daily frequency, 1962-01-02 to 2012-06-07.
Units: Percentage (%).
Stationary: Overall there is not a clear trend though, before the mid 1980s, the interest rate was trending upwards, and after, it slowly decreased from 14% to 2%. For this series we do not have enough knowledge yet to judge the stationarity properties, but it is clear that the sample average (blue line) is not a very representative statistic of the centrality of the process raising some doubts about its first-order stationarity.

d. The U.S. unemployment rate
Plot: Refer to Figure 6.
Definition: The unemployment rate represents the number of unemployed people as a percentage of the labor force. Labor force is people 16 years of age and older, who currently reside in one of the 50 states or the District of Columbia, 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.
Periodicity: Monthly frequency, 1948-01-01 to 2012-05-01.
Units: Percentage (%).
Stationary: This series is rather different from the previous three. The series crosses the sample time average of around 5.8% more often than in the previous three series, but the peaks and dips seem to be very persistent meaning that the series lingers around the same area for extended periods of time. The most that we can say by now is that this series seems to be more stationary than the

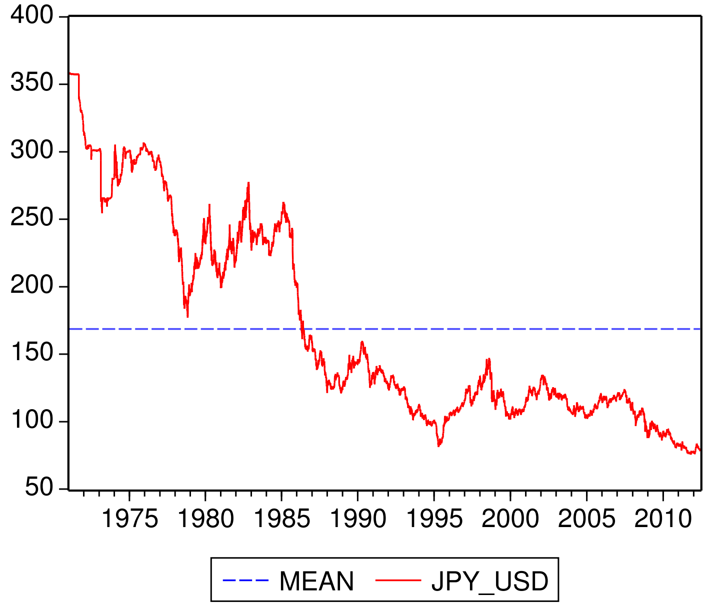


Figure 4: Time Series Plot of JPY_USD

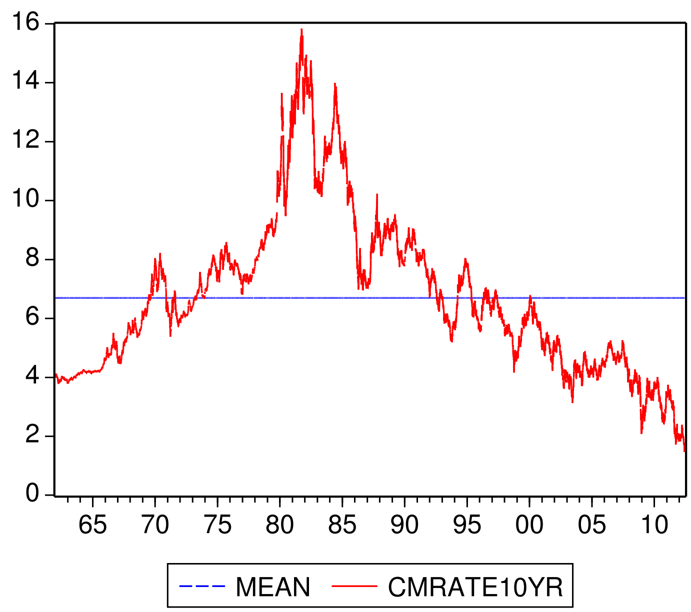


Figure 5: Time Series Plot of $CMRATE10YR$

interest rate series but we need to learn more about the meaning of statistical persistence to offer a final judgment.

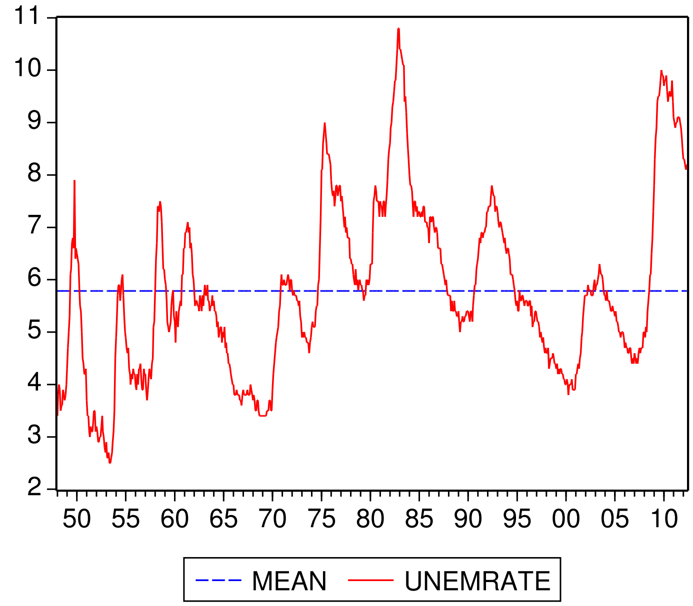


Figure 6: Time Series Plot of $UNEMRATE$

Exercise 4

a. $LY_t = Y_{t-1}$

b. $Lc = c$

c. $L^2Y_t = Y_{t-2}$

d. $L^kY_t = Y_{t-k}$, for some $k > 0$

e. $Y_t - LY_t = Y_t - Y_{t-1} = \Delta Y_t$

Note: in the following questions f. and g. there is a typo in the textbook. The questions should start from α on.

f. $\alpha + (1 - \rho L)Y_t = \alpha + Y_t - \rho Y_{t-1}$

g. $\alpha + (1 - \rho_1 L + \rho_2 L^2)Y_t + LX_t = \alpha + Y_t - \rho_1 Y_{t-1} + \rho_2 Y_{t-2} + X_{t-1}$

Exercise 5

a. Figure 7 shows that the underlying stochastic process is not weakly stationary. The upward trend indicates that the process must have different means in different periods of time, so that it is not first order stationary.

b. The growth rate of nominal GDP is reported in the third column of Table 4.

c. The logarithmic transformation helps to stabilize the variance. Figures 7 and 8 show that the log transformation does not affect the trending behavior of the GDP series, and therefore, y_t is not first order stationary but it is smoother than the original GDP series.

d. The value of g_{2t} is reported in the fifth column of Table 4.

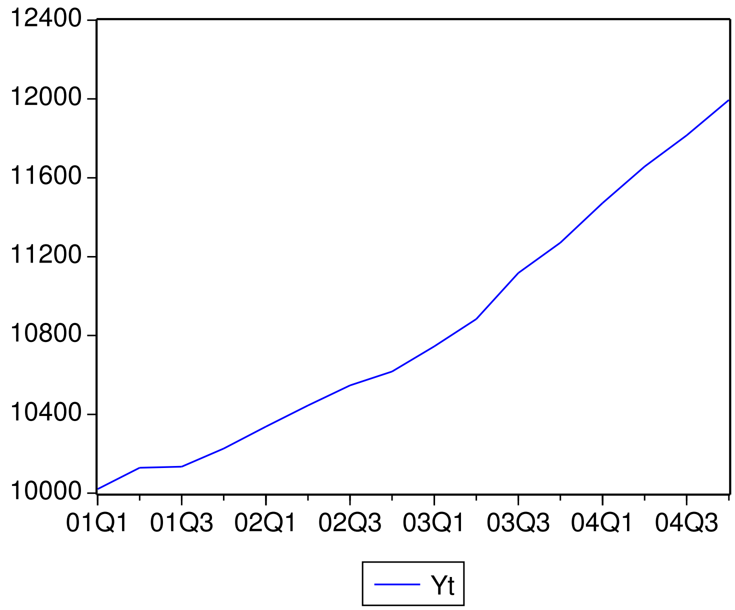


Figure 7: Time Series Plot of Nominal GDP

Date	GDP	g_{1t}	LGDP	g_{2t}
1/1/2001	10021.5		9.212488064	
4/1/2001	10128.9	1.071695854	9.223148003	1.065993896
7/1/2001	10135.1	0.06121099	9.223759926	0.061192264
10/1/2001	10226.3	0.899843119	9.232718112	0.895818656
1/1/2002	10338.2	1.094237407	9.243601052	1.088293948
4/1/2002	10445.7	1.039832853	9.253945689	1.034463779
7/1/2002	10546.5	0.964990379	9.26354933	0.960364085
10/1/2002	10617.5	0.673209122	9.270258862	0.670953188
1/1/2003	10744.6	1.197080292	9.282158582	1.189971958
4/1/2003	10884	1.297395901	9.2950491	1.289051814
7/1/2003	11116.7	2.138000735	9.316203761	2.115466127
10/1/2003	11270.9	1.387102288	9.329979462	1.37757007
1/1/2004	11472.6	1.789564276	9.347716863	1.773740085
4/1/2004	11657.5	1.611666057	9.363705029	1.598816596
7/1/2004	11814.9	1.350203732	9.377116726	1.341169709
10/1/2004	11994.8	1.522653598	9.392228502	1.511177575

Table 4: GDP and Growth rates

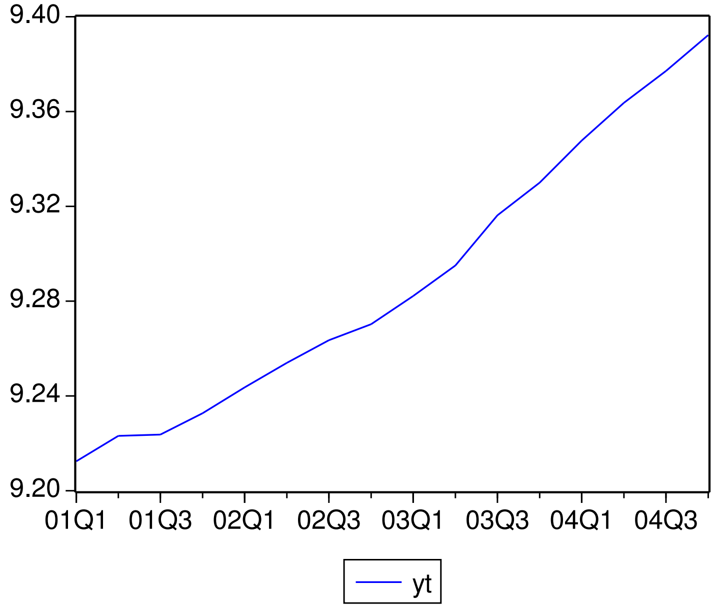


Figure 8: Plots for LNGDP

e. From the third and the fifth columns of Table 4, we observe that there are not significant differences between g_{1t} and g_{2t}, so that the log-difference used in d. is a good approximation to compute growth rates.

Exercise 6

a. $\hat{\mu} = 1.1983\%$, $\hat{\gamma}_0 = 0.2334$˙ b. The autocorrelations in Table 5 are positive meaning that the observations that are 1 quarter, 2 quarters, 3 quarters and 4 quarters apart move in the same direction. See Figures 9, 10, 11 and 12. Positive (negative) growth tends to be followed by positive (negative) growth and, on average, this inertia is maintained at least for four quarters. Observe that the autocorrelations become smaller as k increases and eventually they will fade away.

k	$\hat{\rho}_k$
1	0.428
2	0.336
3	0.138
4	0.105

Table 5: Autocorrelation Function of g_{2t}

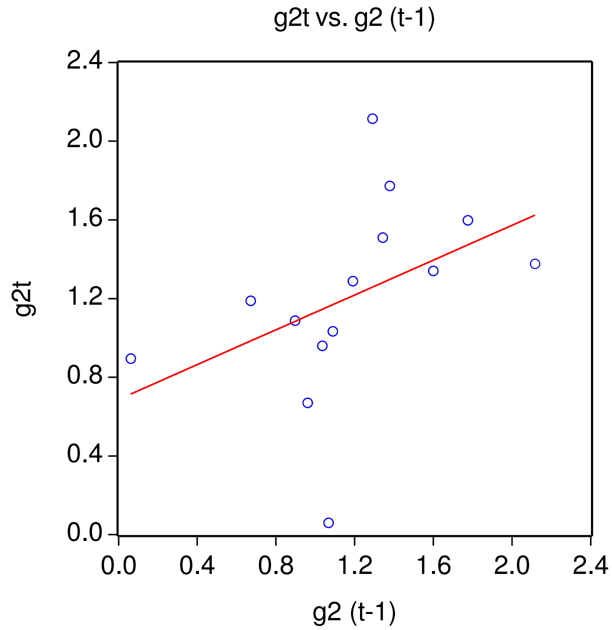


Figure 9: g_{2t} against g_{2t-1}

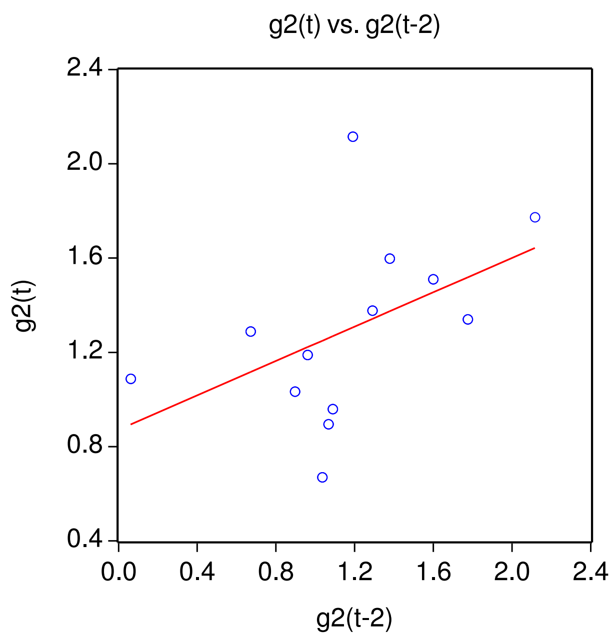


Figure 10: $g_{2,t}$ against $g_{2,t-2}$

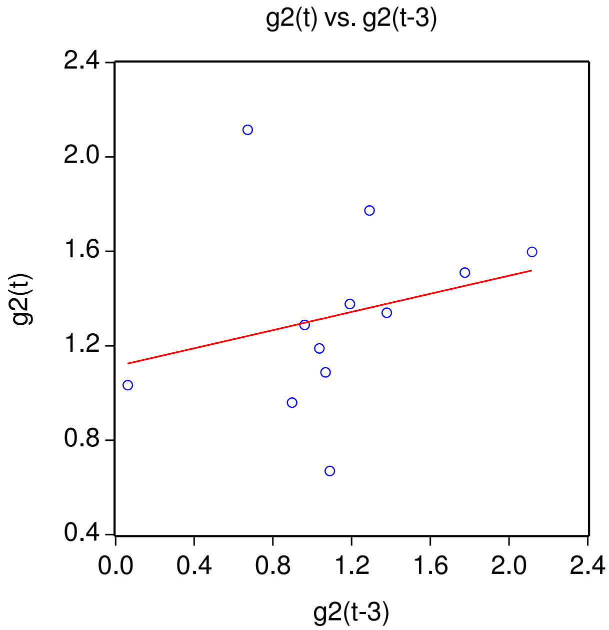


Figure 11: g_{2t} against g_{2t-3}

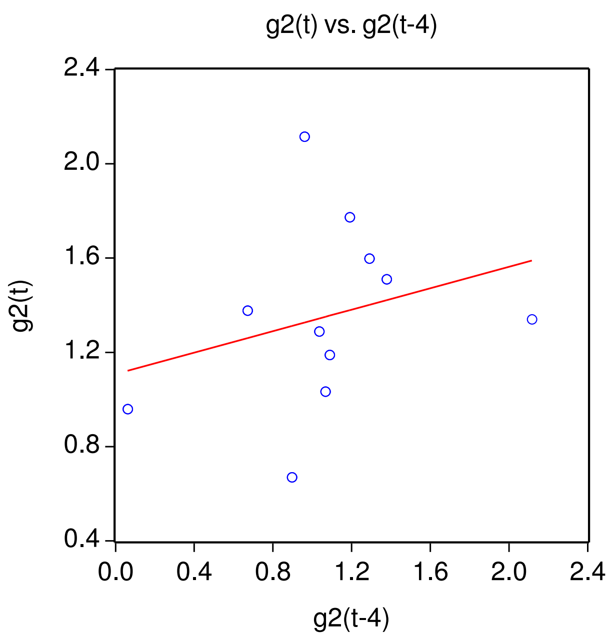


Figure 12: g_{2t} against g_{2t-4}

Exercise 7
a. The daily return (%) is calculated as the log-difference of the index, i.e. $R_t = 100 \times (\log P_t - \log P_{t-1})$. As an example, Table 6 shows the daily returns from January 3, 2006 to January 19 2006.

b. Refer Table 7 and Figure 13. Observe that the sample mean return is practically zero, with mild negative asymmetry, and heavy tails as the result of a few but very large positive and negative returns.

Date	Return
1/3/2006	
1/4/2006	1.629696
1/5/2006	0.366603
1/6/2006	0.001571
1/9/2006	0.935554
1/10/2006	0.364964
1/11/2006	-0.033335
1/12/2006	0.345215
1/13/2006	-0.629401
1/17/2006	0.120451
1/18/2006	-0.364126
1/19/2006	-0.390494

Table 6: Daily Return (% return)

Mean	Variance	Skewness	Kurtosis
0.003	2.070	-0.341	11.367

Table 7: Descriptive Statistics of Daily Returns

c. Refer to Figures 14, 15, 16, and 17. From a regression perspective, the common feature to these four figures is that there is not practically any linear relation between today's return and any of the four past returns.

Exercise 8
a. Refer to Table 11.
b. To compute the conditional means we run three linear regression models. The estimation results are in Tables 8, 9, and 10. The adjusted R-squared in these three models is practically zero, which means that past returns do not explain the sample variation of current returns. A linear model is not suitable to predict current returns. In Figures 18, 19 and 20 we compare the fitted return provided by the regression model (red time series) with the actual return (blue time series). The poor fit of the model is obvious as the differences between the actual and fitted values (residuals) are very large.

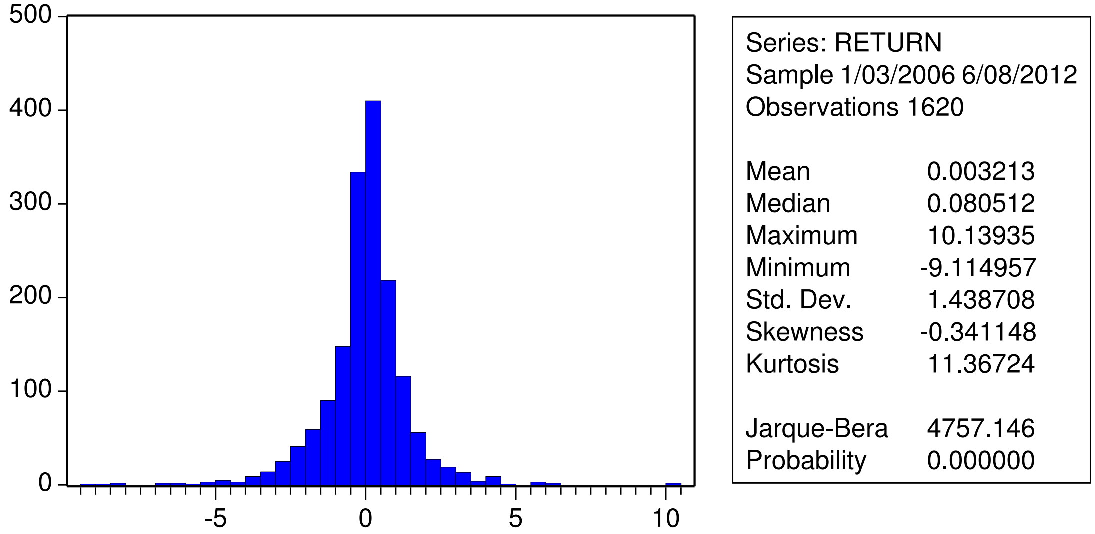


Figure 13: Histogram of Returns

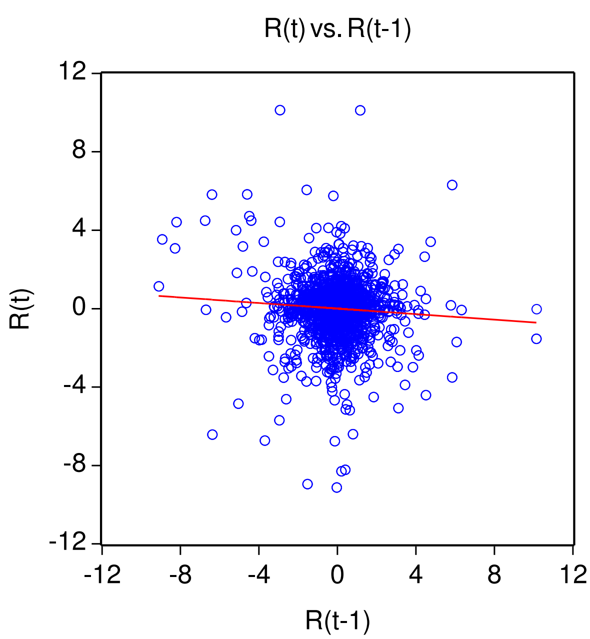


Figure 14: R_t against R_{t-1}

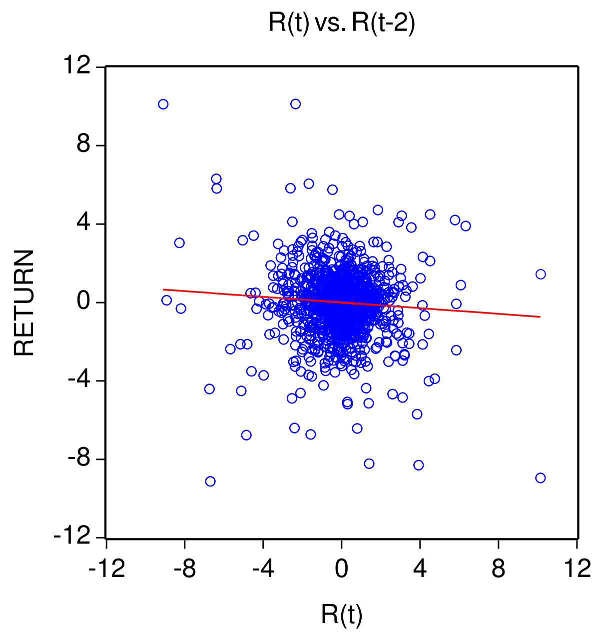


Figure 15: R_t against R_{t-2}

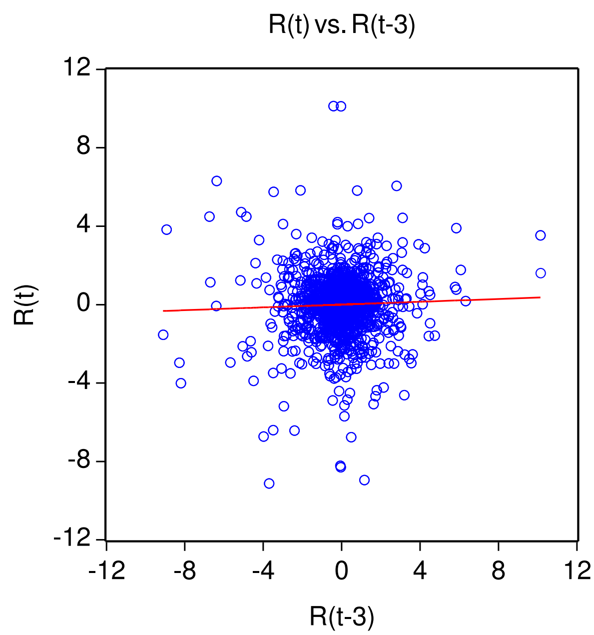


Figure 16: R_t against R_{t-3}

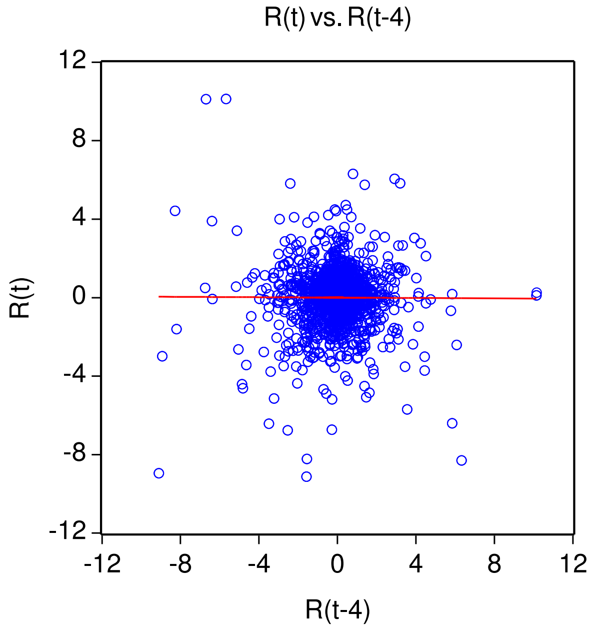


Figure 17: R_t against R_{t-4}

Dependent Variable: RETURN				
Method: Least Squares				
Sample (adjusted): 1/05/2006 6/08/2012				
Included observations: 1619 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002441	0.035674	0.068412	0.9455
RETURN(-1)	-0.07093	0.024796	-2.8605	0.0043
R-squared	0.005035	Mean dependent var		0.002209
Adjusted R-squared	0.004419	S.D. dependent var		1.438584
S.E. of regression	1.435401	Akaike info criterion		3.562001
Sum squared resid	3331.629	Schwarz criterion		3.568658
Log likelihood	-2881.44	F-statistic		8.182477
Durbin-Watson stat	2.011413	Prob(F-statistic)		0.004284

Table 8: Regression of R_t on R_{t-1}

Dependent Variable: RETURN				
Method: Least Squares				
Sample (adjusted): 1/06/2006 6/08/2012				
Included observations: 1618 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002299	0.035598	0.06457	0.9485
RETURN(-1)	-0.07667	0.024808	-3.09077	0.0020
RETURN(-2)	-0.07773	0.024818	-3.13208	0.0018
R-squared	0.011071	Mean dependent var		0.001983
Adjusted R-squared	0.009846	S.D. dependent var		1.439
S.E. of regression	1.431898	Akaike info criterion		3.557731
Sum squared resid	3311.285	Schwarz criterion		3.567723
Log likelihood	-2875.2	F-statistic		9.040056
Durbin-Watson stat	1.99615	Prob(F-statistic)		0.000125

Table 9: Regression of R_t on R_{t-1} and R_{t-2}

Dependent Variable: RETURN				
Method: Least Squares				
Sample (adjusted): 1/10/2006 6/08/2012				
Included observations: 1616 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001619	0.035647	0.045429	0.9638
RETURN(-1)	-0.07647	0.024839	-3.07844	0.0021
RETURN(-2)	-0.07846	0.024909	-3.14986	0.0017
RETURN(-4)	-0.00776	0.024852	-0.31202	0.7551
R-squared	0.011157	Mean dependent var		0.001406
Adjusted R-squared	0.009317	S.D. dependent var		1.439703
S.E. of regression	1.432981	Akaike info criterion		3.559863
Sum squared resid	3310.136	Schwarz criterion		3.573199
Log likelihood	-2872.37	F-statistic		6.062668
Durbin-Watson stat	1.997224	Prob(F-statistic)		0.000421

Table 10: Regression of R_t on R_{t-1}, R_{t-2} and R_{t-4}

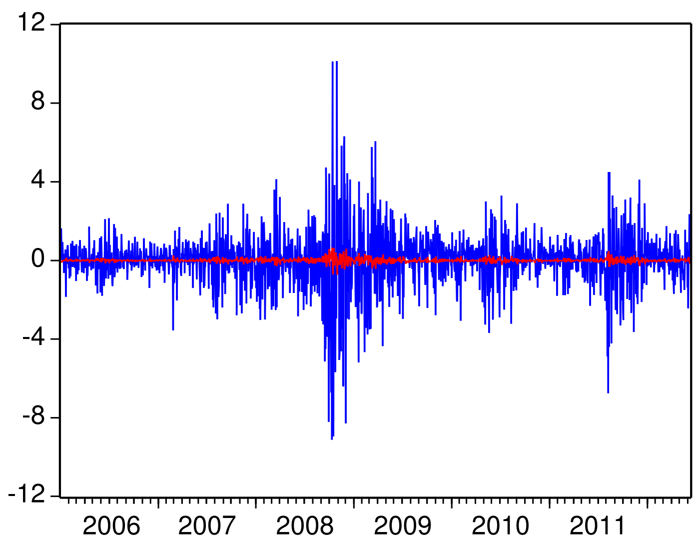


Figure 18: Actual (blue) and Fitted (red) Return from Regression $E(R_t|R_{t-1})$

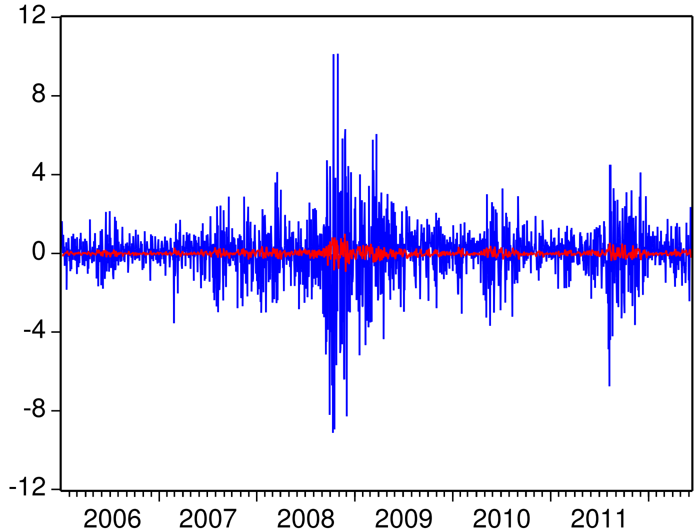


Figure 19: Actual (blue) and Fitted (red) Return from Regression $E(R_t|R_{t-1}, R_{t-2})$

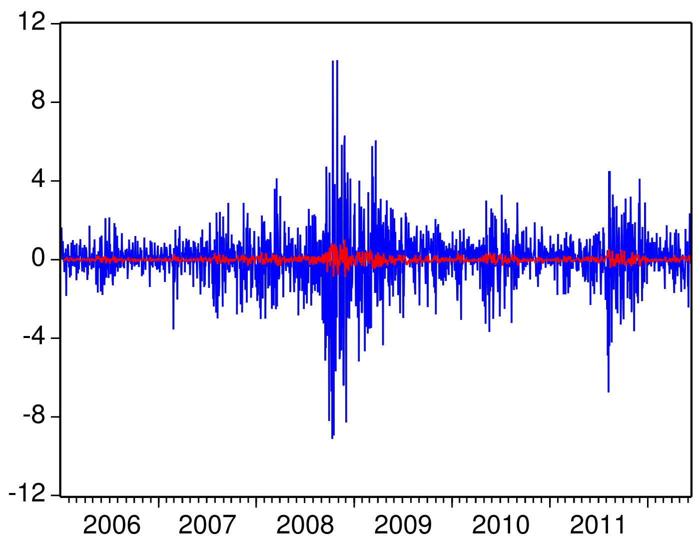


Figure 20: Actual (blue) and Fitted (red) Return from Regression $E(R_t|R_{t-1}, R_{t-2}, R_{t-4})$

Exercise 9

Table 11 reports the t-ratios and Q-statistics for the autocorrelation and partial autocorrelation functions. For the single hypothesis $H_0 : \rho_k = 0$ and $H_1 : \rho_k \neq 0$, the t-ratio is $\hat{\rho}_k/\sqrt{1/T}$. For a 5% significance level, we will reject the null hypothesis whenever $|\hat{\rho}_k/\sqrt{1/T}| > 1.96$. Likewise for the partial autocorrelations $\hat{r}_k$. For the joint hypothesis $H_0 : \rho_1 = \rho_2 = ... = \rho_k = 0$ and H_1 : Negation of H_0, the Q-statistic is

$$Q_k = T(T+2)\sum_{j=1}^{k}\frac{\hat{\rho}_j^2}{T-j}\hat{\rho}_j^2 \to \chi_k^2.$$

and we will reject the null when Q_k is larger than the corresponding critical value of a chi-square density with k degrees of freedom.

According to the t-ratio, we reject the single null hypothesis for lags 1, 2, and 5. According to the Q-statistic, we reject the joint hypothesis for any k. Overall, there is statistically significant negative autocorrelation for a couple of days indicating that, on average, two consecutive days of negative (positive) returns will give rise to a positive (negative) return in the following day. However, the autocorrelation is extremely weak and it will not be very meaningful as a prediction tool.

	ACF		PACF			
k	$\hat{\rho}_k$	t-ratio	$\hat{r}_k$	t-ratio	Q-Stat	Prob
1	-0.071	-2.858	-0.071	-2.858	8.165	0.004
2	-0.072	-2.898	-0.078	-3.140	16.624	0.000
3	0.036	1.449	0.025	1.006	18.701	0.000
4	-0.005	-0.201	-0.006	-0.241	18.738	0.001
5	-0.052	-2.093	-0.049	-1.972	23.086	0.000
6	0.022	0.885	0.013	0.523	23.877	0.001
7	-0.034	-1.368	-0.039	-1.570	25.754	0.001
8	0.023	0.926	0.023	0.926	26.612	0.001
9	-0.008	-0.322	-0.012	-0.483	26.713	0.002
10	0.035	1.409	0.037	1.489	28.694	0.001
11	-0.011	-0.442	-0.007	-0.281	28.887	0.002
12	0.034	1.368	0.036	1.449	30.826	0.002

Table 11: ACF, PACF and Q-statistics

Exercise 10

The ACF and PACF for the four time series are shown in Figures 21, 22, 23 and 24 respectively. We claim the same single and joint hypothesis as in Exercise 9, and proceed with the implementation of t-ratios and Q-statistics. The vertical dashed lines in the figures denote the 95% confidence interval, centered at zero, for each individual autocorrelation coefficient. The columns named *Q-Stat* and *Prob* report the Q-statistics and their corresponding p-values.

a. and b. U.S. real GDP and the exchange rate of the Japanese yen against U.S. dollar
Refer to Figures 21 and 22. Both figures are very similar. The t-ratios show that each autocorrelation coefficient is very significant and very large; the first partial autocorrelation coefficient is around one and very significant. Not surprisingly the Q-statistics are very large and reject very

strongly the joint hypothesis (p-values are 0).

The ACF and PACF for these series indicate that there is a strong positive autocorrelation that remains for a long time. There is high persistence in national product and in exchange rates to the extent that we can claim that next period national product or exchange rate will not be very different from the current period levels. In the forthcoming chapters we will characterize statistically these processes as non-stationary, which was already our conclusion in Exercise 3.

c. and d. The 10-year U.S. Treasury constant maturity yield and the U.S. unemployment rate
Refer to Figures 23 and 24. These two figures have commonalities with those in a. and b. The ACFs are very similar with very large positive autocorrelation coefficients that are strongly significant. We observe faster decay of the autocorrelation in the unemployment series than in the yield series but nevertheless the autocorrelation is still very persistent. The PACFs have a strong and large one-lag autocorrelation (same feature as in the PACFs in a. and b.) but they show more significant partial autocorrelations than those in a. and b. See that up to lags 6 or 7, the coefficients are significant though they become smaller as the lags increase. Since the ACFs are similar to those in a. and b., we suspect that the process may also be non-stationary, and since the PACFs are different, our claim about the future behavior of yields or unemployment must be a function not just of the immediate past information but also of the more remote past information.

At this point, the student should link the time series plots in Exercise 3 with their corresponding ACF and PACF. The objective is start introducing the idea of time series models that will summarize the information of the ACF and PACF.

Sample: 1947Q1 2012Q1
Included observations: 261

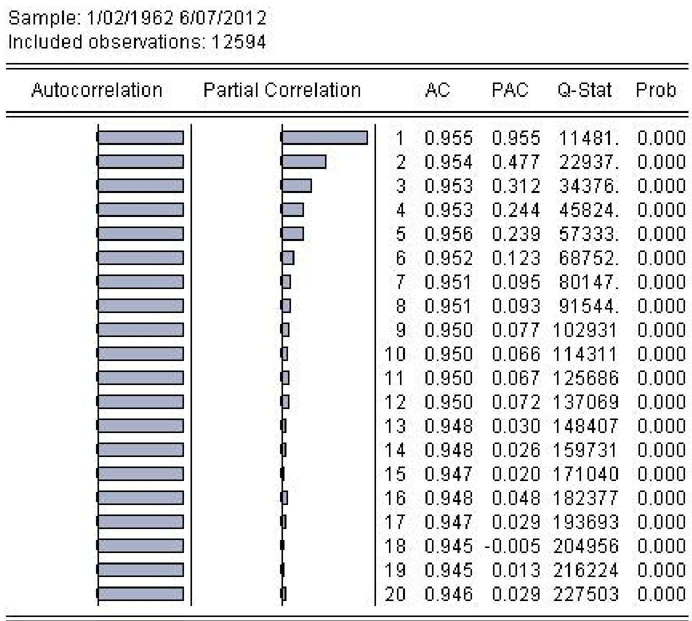
	AC	PAC	Q-Stat	Prob
1	0.990	0.990	258.56	0.000
2	0.979	-0.013	512.61	0.000
3	0.968	-0.008	762.17	0.000
4	0.958	-0.007	1007.2	0.000
5	0.947	-0.008	1247.8	0.000
6	0.936	-0.009	1483.9	0.000
7	0.926	-0.005	1715.5	0.000
8	0.915	-0.005	1942.6	0.000
9	0.904	-0.003	2165.4	0.000
10	0.894	-0.003	2383.8	0.000
11	0.883	-0.001	2598.0	0.000
12	0.873	-0.009	2807.9	0.000
13	0.862	-0.009	3013.6	0.000
14	0.851	-0.030	3214.7	0.000
15	0.839	-0.037	3411.2	0.000
16	0.827	-0.023	3602.7	0.000
17	0.815	-0.009	3789.4	0.000
18	0.802	-0.018	3971.2	0.000
19	0.790	-0.006	4148.2	0.000
20	0.777	-0.006	4320.3	0.000

Figure 21: ACF, PACF and Q-Statistic of $RGDP$

Sample: 1/04/1971 6/01/2012
Included observations: 10391

	AC	PAC	Q-Stat	Prob
1	1.000	1.000	10384.	0.000
2	0.999	-0.008	20759.	0.000
3	0.999	-0.003	31125.	0.000
4	0.998	-0.003	41481.	0.000
5	0.998	-0.000	51829.	0.000
6	0.997	-0.005	62167.	0.000
7	0.997	-0.004	72495.	0.000
8	0.996	-0.003	82815.	0.000
9	0.996	-0.002	93124.	0.000
10	0.995	-0.008	103424	0.000
11	0.995	-0.007	113715	0.000
12	0.994	0.000	123995	0.000
13	0.993	-0.004	134266	0.000
14	0.993	-0.004	144527	0.000
15	0.992	-0.000	154777	0.000
16	0.992	0.001	165018	0.000
17	0.991	0.002	175249	0.000
18	0.991	-0.003	185471	0.000
19	0.990	-0.003	195682	0.000
20	0.990	-0.006	205883	0.000

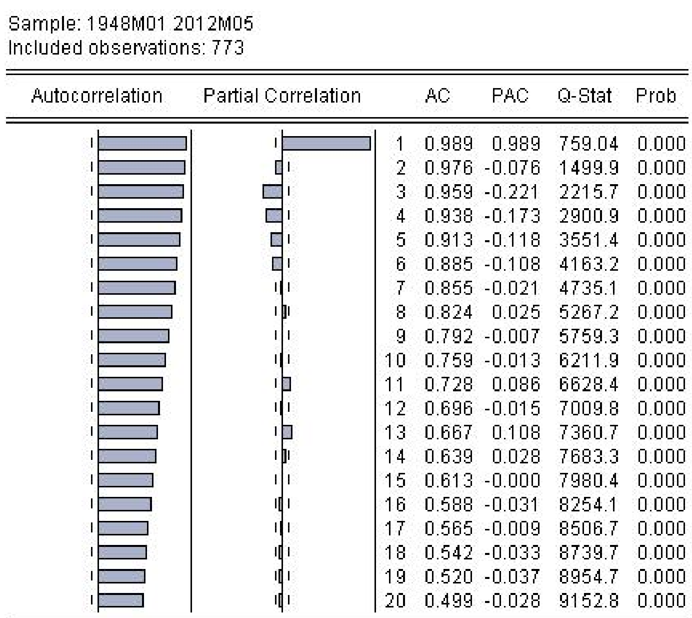
Figure 22: ACF, PACF and Q-Statistic of JPY_USD



Sample: 1/02/1962 6/07/2012
Included observations: 12594

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.955	0.955	11481.	0.000
		2	0.954	0.477	22937.	0.000
		3	0.953	0.312	34376.	0.000
		4	0.953	0.244	45824.	0.000
		5	0.956	0.239	57333.	0.000
		6	0.952	0.123	68752.	0.000
		7	0.951	0.095	80147.	0.000
		8	0.951	0.093	91544.	0.000
		9	0.950	0.077	102931	0.000
		10	0.950	0.066	114311	0.000
		11	0.950	0.067	125686	0.000
		12	0.950	0.072	137069	0.000
		13	0.948	0.030	148407	0.000
		14	0.948	0.026	159731	0.000
		15	0.947	0.020	171040	0.000
		16	0.948	0.048	182377	0.000
		17	0.947	0.029	193693	0.000
		18	0.945	-0.005	204956	0.000
		19	0.945	0.013	216224	0.000
		20	0.946	0.029	227503	0.000

Figure 23: ACF, PACF and Q-Statistic of $CMRATE10YR$



Sample: 1948M01 2012M05
Included observations: 773

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.989	0.989	759.04	0.000
		2	0.976	-0.076	1499.9	0.000
		3	0.959	-0.221	2215.7	0.000
		4	0.938	-0.173	2900.9	0.000
		5	0.913	-0.118	3551.4	0.000
		6	0.885	-0.108	4163.2	0.000
		7	0.855	-0.021	4735.1	0.000
		8	0.824	0.025	5267.2	0.000
		9	0.792	-0.007	5759.3	0.000
		10	0.759	-0.013	6211.9	0.000
		11	0.728	0.086	6628.4	0.000
		12	0.696	-0.015	7009.8	0.000
		13	0.667	0.108	7360.7	0.000
		14	0.639	0.028	7683.3	0.000
		15	0.613	-0.000	7980.4	0.000
		16	0.588	-0.031	8254.1	0.000
		17	0.565	-0.009	8506.7	0.000
		18	0.542	-0.033	8739.7	0.000
		19	0.520	-0.037	8954.7	0.000
		20	0.499	-0.028	9152.8	0.000

Figure 24: ACF, PACF and Q-Statistic of $UNEMRATE$

