Impacts of Dollar Depreciation and Low Deposit Rates on the US Economy

Yu Hsing[1]

ABSTRACT

Extending Irving Fisher's intertemporal budget constraint, applying the GARCH model, and based on the equilibrium in aggregate demand and aggregate supply, it is found that a weak US dollar helps real output and that low deposit rates reduce interest income, consumption spending and aggregate demand. Real GDP is also negatively affected by the personal loan rate and the business lending rate, and it is positively influenced by deficit spending, household wealth, and consumer confidence. In conducting monetary policy, the Federal Reserve may need to monitor the loss in interest income and other adverse impacts due to low deposit rates.

1. INTRODUCTION

RECENTLY, CHANGES IN two major macroeconomic variables have caught the attention of economic commentators. First, the US dollar has become weaker against some major currencies. For example, the US dollar declined 15.7 percent against the British pound from June 2001 to July 2003. The exchange rate of the Japanese yen per US dollar decreased 11.2 percent from 133.64 in February 2002 to 118.78 in July 2003. Likewise, the exchange rate of Euro per US dollar also dropped 24.9 percent from 1.1723 in June 2001 to 0.8799 in July 2003. The depreciation of the US dollar may affect real output in different ways. On the one hand, imports become more expensive and may cause domestic prices to rise and aggregate supply to shift to the left. On the other hand, a weaker dollar is expected to help exports and affect other related economic variables. The net effect depends upon relative changes in aggregate demand and aggregate supply. Second, interest rates have been on the decline and may stay at this level for a while. Following the decrease of the targeted federal funds rate from 6.50 percent in June 2000 to 1.00 percent in June 2003, the interest rate for a 6-month CD declined by 84.9 percent from a high of 6.94 percent in May 2000 to a low of 1.05 percent in July 2003. Low deposit rates may provide less incentive to save, hurt savers' interest income,

and increase or reduce consumption spending depending on the relative weights of the substitution and income effects. Low lending rates are likely to increase borrowing by firms and households. The net effect of low interest rates on real output needs to be tested empirically.

The purpose of this paper is to examine the net effects of dollar depreciation and low interest rates on US real output and differs from previous studies in several aspects. First, the assumption of one interest rate in Irving Fisher's intertemporal budget constraint is relaxed in order to separate the deposit rate from the lending rate so that the potential for different impacts may be measured and tested. The conventional approach of using one representative rate may cancel out their separate effects. Second, the wealth variable is considered. It is well known that wealth is expected to affect household consumption spending. A sharp decrease in financial wealth as some had experienced may affect their consumption spending. Third, the generalized autoregressive conditional heteroscedasticity or GARCH(p,q) process is applied to time series data in order to determine whether the error variance may be a function of past squared errors and past variances.

2. Literature survey

The overall impact of the real interest rate on output has been examined extensively. Jorgenson (1963) found a significant negative impact of the interest rate on investment spending. Taylor (1993) stated that the real interest rate has a significant negative effect on residential investment, business equipment, and business structures in the US and on fixed investments in all G-7 countries. He also indicated that inventory investment and consumption spending are very sensitive to the real interest rate in many of these nations. Romer and Romer (1994) showed strong evidence that a higher federal funds rate is harmful to real GDP for the US based on the data after World War II. Taylor (1995) further showed that, although the elasticity of investment with respect to the interest rate has decreased, the elasticity of consumption with respect to the interest rate has risen. Overall, there were no declining or increasing trends for the G-7 nations. He found that a temporary decrease in interest rates would cause real output to rise temporarily for approximately two years or longer. On the other hand, Stiglitz and Greenwald (1993), Eichenbaum (1994), and Bernanke and Gertler (1995) maintained that the interest rate elasticity is not significant statistically, that the cost-of-capital effect is weak, and that monetary policy mainly affects short-term rates whereas households and firms respond to long-term rates in deciding whether to purchase long-term assets. Recent research (Estrella, 2002; Boivin and Giannoni, 2002) indicated that the effect of interest rates on real output has declined since the 1980s mainly due to financial innovation, better inventory management, securitization, the conduct of monetary policy and so on. In view of these different views, it is important to investigate the potential effect of real interest rates on real output further.

Several studies have attempted to estimate the impacts of currency depreciation and/or monetary policy on real output. Edwards (1986) considered a monetary policy variable, a fiscal policy variable, the real exchange rate, etc. in a regression analysis using a sample of 12 developing nations during the period 1965-1980. He found currency depreciation to have a negative effect in the first year, a positive impact in the second year, and to be neutral in the long run. He also indicated that an unexpected increase in the growth of nominal money supply and an increase in the ratio of government spending to GDP have positive effects on real output.

Morley (1992) concentrated on the potential impact of depreciation on capacity utilization based on data from 19 countries since 1974. He indicated that depreciation causes a negative effect on real output mainly because of a significant decline in investment spending. The coefficients for fiscal and monetary policy are insignificant in most of the reported results, while terms of trade have a positive effect.

Moreno (1999) investigated the impacts of depreciation, monetary policy, fiscal policy, foreign output and the real federal funds rate on real output, consumption and investment based on the data from six East Asian countries during 1975-1996. The impacts on real GDP depend upon the time periods covered and the regression techniques used. During the full sample period, depreciation has a significant negative impact in the OLS regression and is insignificant in the instrumental variable regression. Nominal M2 is insignificant. Real government spending is significant. The real federal fund rate has mixed results.

Upadhyaya (1999) found that in the long run, currency depreciation has a negative impact on real output for Thailand and Pakistan and has no effect for India, Malaysia, the Philippines, and Sri Lanka. Kamin and Rogers (2000) employed the VAR model to find that the depreciation of Mexican peso has caused decline in real output and high inflation. They suggest that targeting the peso to promote exports without regard to potential adverse effects may be highly risky.

3. THE MODEL

This study extends and applies the works of Agenor (1991), Gavin (1992), Moreno (1999), and others to determine real output based on the equilibrium in aggregate demand and aggregate supply and the assumption that monetary policy or the interest rate is exogenous.[2] Suppose that consumption spending is a function of disposable income, the real interest rate, wealth and consumer confidence, that investment spending is determined by the real interest rate, and that net exports are determined by the real exchange rate. In equilibrium where aggregate demand equals aggregate supply, we have the following reduced-form equation:

$$Y = f(EX, RR, GV, TX, WE, CC) \qquad [1]$$

where:

Y = real GDP;
EX = the real effective exchange rate;
RR = the real interest rate;
GV = real government spending;
TX = real government tax revenue;
WE = real wealth;
CC = consumer confidence.

If we break down the representative interest rate into the deposit rate for savers, the personal loan rate for household borrowers, and the lending rate for business borrowers, we have:

$$Y = f(EX, DR, PR, LR, GV, TX, WE, CC) \quad [2]$$

where:

DR = the real deposit rate;
PR = the real personal loan rate;
LR = the real business lending rate.

The budget deficit will be considered in order to test if deficit spending would affect real output. The equation to be estimated in empirical work is written as:

$$Y = f(EX, DR, PR, LR, DE, WE, CC) \quad [3]$$

where *DE* stands for real government deficits $(GV - TX)$. We expect that the sign of $\partial(Y)/\partial(WE)$ and $\partial(Y)/\partial(CC)$ is positive, that the sign of $\partial(Y)/\partial(PR)$ and $\partial(Y)/\partial(LR)$ is negative, and that the sign of $\partial(Y)/\partial(EX)$ and $\partial(Y)/\partial(DR)$ is uncertain, and that the sign of $\partial(Y)/\partial(DE)$ is nonnegative.

As mentioned, the impact of dollar depreciation on real GDP is uncertain partly depending upon whether the loss in higher import or domestic prices would outweigh the gain in exports and other areas. Other possible impacts of dollar depreciation include lower real income, lower consumption spending, lower real wealth, lower real interest rates, more investment spending, among others.

For savers, an increase in the deposit rate is expected to have a negative substitution effect and a positive income effect on current consumption. The net impact is uncertain depending upon whether the substitution effect is greater or less than the income effect. An increase in the personal loan rate is expected to have a negative substitution effect and a negative income effect on current consumption and real GDP. Therefore, the total effect is expected to be negative. An increase in the business lending rate is likely to raise the cost of borrowing, hurt investment spending, and reduce real GDP.

Theoretically, the sign of the budget deficit, $DE = (GV - TX)$, is expected to be positive because an increase in a budget deficit can be achieved through a decrease in *TX* or an increase in *GV* or both. Aggregate demand will increase

under either one of the cases. On the other hand, Ricardian equivalence theory indicates that the effect of deficit-financed spending is neutral in the long run. The sign of *WE* is expected to be positive as life-cycle consumption theory suggests. An increase in consumer confidence is likely to increase household spending and aggregate demand.

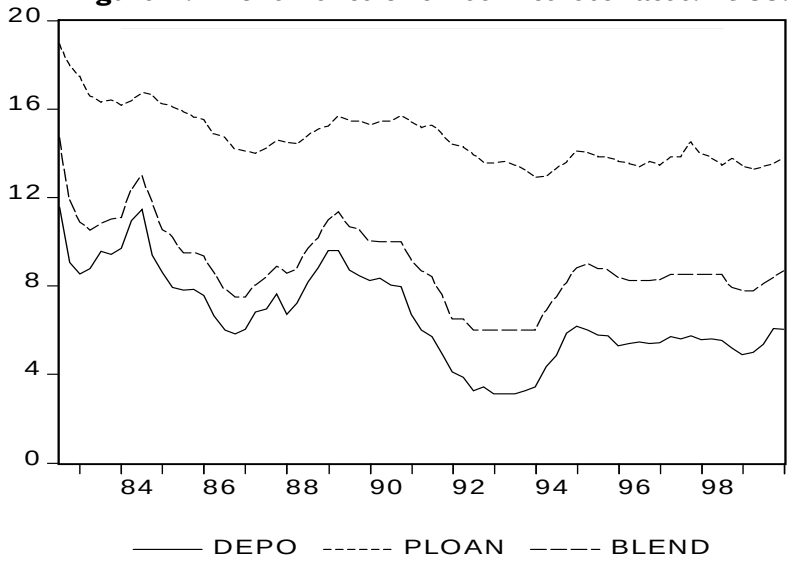
Equation (3) will be estimated by the OLS as well as the GARCH(*p,q*) model, in which the error variance is a function of past squared errors and past error variances (Enders, 1995):

$$v_t = \beta_0 + \sum_{j=1}^{p} \beta_j \varepsilon_{t-j}^2 + \sum_{j=1}^{q} \theta_j v_{t-j} \qquad [4]$$

4. EMPIRICAL RESULTS

The sample ranges from 1982:Q3 to 2000:Q1. For some of the variables, data earlier or later than this period are not available. Definitions and data sources of the variables are described in table 1. The real effective exchange rate is defined as the ratio of major currencies per US dollar divided by the ratio of the price in the US to the price in representative countries. Therefore, an increase in real effective exchange rates means an appreciation of the US dollar, and vice versa. All the variables are expressed in logarithms except for the deficit variable, which is in level form due to negative values for some of quarters. To reduce a high degree of multicollinearity and allow for time lags, the prime lending rate (*LR*) and consumer confidence are lagged one quarter. Figure 1 shows how the three interest rates in levels moved together during the sample period.

Figure 1. Movements of three interest rates: 1983:Q2-2000:Q1



Notes:

PLOAN: the personal loan rate,

BLEND: the prime lending rate.

DEPO: the deposit rate.

Table 1: Variable definitions and data sources

Y	Real GDP (billions of 1996 dollars)	International Financial Statistics
EX	Real effective exchange rate (1995 = 100)	International Financial Statistics
DR	Real certificate of deposit rate 3 month	International Financial Statistics
PR	Real personal loan rate	Federal Reserve Bank
LR	Real prime lending rate	International Financial Statistics
DE	Real federal budget deficits (billions of dollars)	International Financial Statistics
WE	Real wealth (billions of dollars)	Federal Reserve Board
CC	Consumer confidence index	Confidence Board

Note: The consumer price index was used to derive real values except for real GDP.

The unit root test is performed first. Based on the ADF test in table 2, all the variables except for PR have unit roots in levels at the 5 per cent level, but all the variables are stationary in first difference at the 5 per cent level. The Johansen (1991) cointegration test is performed next. The null hypothesis of a zero cointegrating relationship is tested against the alternative hypothesis of

Table 2: ADF Test for unit roots and cointegrating equation: 1983(2)-2000(1)

Variable	*Test statistic* (intercept)*	*Test Statistic** (Intercept and trend)*	*Test Statistic* (Intercept)*	*Test Statistic** (Intercept and trend)*
	Level	*Level*	*First dif.*	*First dif.*
Y	-1.85	-3.28	-3.97	-4.17
EX	-1.77	-0.40	-3.85	-4.32
DR	-1.89	-2.42	-3.78	-3.69
PR	-3.34	-3.37	-5.11	-5.30
LR	-2.56	-2.87	-4.01	-3.84
DE	-1.97	-2.01	-2.70	-2.27
WE	-1.46	0.10	-5.30	-5.54
CC	-2.77	-2.70	-5.83	-5.83

Notes: * Critical values are -3.52, -2.90 and -2.59 at the 1%, 5% and 10% levels, respectively.** Critical values are -4.08, -3.47 and -3.16 at the 1%, 5% and 10% levels, respectively. Phillips-Perron unit root tests in first difference for DE show that the test statistics are -7.96 and -7.92, respectively and that nonstationarity can be rejected.

one cointegrating relationship. A lag length of two is chosen. Assuming no deterministic trend or allowing for a linear deterministic trend in the data with or without an intercept and/or a trend, both the trace test and the max-Eigen test statistics indicate that the null hypothesis of a zero cointegrating relationship between real output and the right-hand side variables can be rejected in favour of one cointegrating relationship. Therefore, real GDP and the explanatory variables have a long-run stable relationship.[3] The estimated cointegrating equation derived from the normalized coefficients via the Johansen VECM is presented in table 2.

Ramsey's RESET test is performed to determine whether the regression may be mis-specified. Considering one fitted term, it is found that the value of the F-statistic is 0.840, which is far below the critical value of 7.08 at the 1 per cent level. Hence, the null hypothesis that the model is mis-specified can be rejected.

The Jarque-Bera test is performed to determine whether the errors are normally distributed. The test statistic follows a χ^2 distribution with two degrees of freedom and was calculated to be 0.606, which is less than the critical value of 9.21 at the 1 per cent level. Thus, the null hypothesis that the errors are normally distributed cannot be rejected.

Table 3: OLS and GARCH Regressions: 1983:Q2-2000:Q1

Dependent Variable: Y
Method: Least Squares
Sample: 1982:Q3 2000:Q1
Included observations: 71

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Probability*
C	2.067	0.987	2.093	0.040
EX	-0.125	0.053	-2.355	0.021
DR	-0.021	0.029	-0.703	0.484
PR	-0.018	0.104	-0.172	0.863
LR	0.027	0.033	0.795	0.429
DE	0.000	0.000	1.242	0.218
WE	0.663	0.089	7.400	0.000
CC	0.147	0.045	3.283	0.001

R-squared	0.983	Mean dependent var.	8.819
Adjusted R-squared	0.982	S.D. dependent var.	0.161
S.E. of regression	0.021	Akaike info criterion	-4.728
Sum squared resid.	0.029	Schwarz criterion	-4.473
Log likelihood	175.866	*F*-statistic	552.392
Durbin-Watson stat	0.498	Prob (*F*-statistic)	0.000

Table 3: OLS and GARCH Regressions *...continued*

Dependent Variable: Y
Method: ARCH(1)
ML-ARCH (Marquardt)
Sample: 1982:Q3 2000:Q1
Variance backcast: ON

Included observations: 71
Convergence achieved after 32 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	*Std. Error*	*z-statistic*	*Probability*
C	2.525	0.370	6.825	0.000
EX	-0.154	0.018	-8.426	0.000
DR	0.026	0.010	2.605	0.009
PR	-0.081	0.029	-2.784	0.005
LR	-0.038	0.011	-3.485	0.000
DE	0.000	0.000	3.545	0.000
WE	0.692	0.032	21.619	0.000
CC	0.059	0.012	4.934	0.000
Variance equation				
C	0.000	0.000	3.761	0.000
ARCH(1)	0.991473	0.212762	4.66001	0.000

R-squared	0.974	Mean dependent var.	8.819
Adjusted R-squared	0.970	S.D. dependent var.	0.161
S.E. of regression	0.027	Akaike info criterion	-5.266
Sum squared resid.	0.046	Schwarz criterion	-4.948
Log likelihood	196.975	*F*-statistic	259.849
Durbin-Watson	0.211	Prob (*F*-statistic)	0.000

Cointegrating equation:

$$Y = 2.854 + \underset{(3.209)}{0.236}\ EX - \underset{(2.065)}{0.086}\ DR - \underset{(4.963)}{0.739}\ PR + \underset{(5.655)}{0.367}\ LR...$$

$$+ \underset{(5.275)}{0.0007}\ DE + \underset{(9.134)}{1.082}\ WE + \underset{(2.924)}{0.181}\ CC$$

Log likelihood = 858.083.

The OLS regression is presented in table 3. As shown, the coefficients for *DR*, *PR*, *LR*, and *DE* are insignificant at the 10 per cent level. Real GDP is negatively affected by *EX* and positively influenced by *WE* and *CC*. Therefore, if we only use OLS, we may draw a misleading conclusion that all the three interest rates and federal budget deficits do not affect real output.

The GARCH(*p,q*) model is applied to determine whether the error variance may violate the classical properties and whether better parameter estimates

and statistical outcomes may be obtained.[4] The GARCH(1,1) process has an insignificant coefficient for the past residual variance. Coefficients for higher-order GARCH(*p,q*) model are insignificant. According to the ARCH LM test (Engle, 1982), the Obs*R^2 statistic has a c2(1) distribution and is estimated to be 18.808. Compared with the critical value of 6.634 with one degree of freedom at the 1 per cent level, the ARCH(1) process cannot be rejected. The results are presented in the lower portion of table 3.

As shown, all the coefficients are significant at the 1 per cent level. *EX* has a negative sign, suggesting that the depreciation of US dollar in real terms is expected to raise real output mainly because the positive effect on exports outweighs the adverse impact on potential higher import or domestic prices. Because the deposit rate has a positive sign, it implies that raising the deposit rate is expected to increase household interest income to stimulate household spending. On the other hand, each of the lending rates has a negative sign.

Table 4: Regression based on White's methodology: 1982:Q3-2000:Q1

Dependent Variable: *Y*
Method: Least Squares
Sample: 1982:Q3 2000:Q1
Included observations: 71
White heteroskedasticity-consistent standard errors and covariance

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Probability*
C	2.067	0.914	2.260	0.0273
EX	-0.125	0.051	-2.437	0.0176
DR	-0.021	0.030	-0.697	0.4878
PR	-0.018	0.104	-0.73	0.8625
LR	0.027	0.034	0.789	0.4328
DE	0.000	0.000	1.338	0.1855
WE	0.663	0.080	8.263	0.0000
CC	0.147	0.042	3.487	0.0009

R-squared	0.983	Meandependentvariable	8.819
Adjusted R-squared	0.982	S.D. dependent variable	0.161
S.E. of regression	0.021	Akaike info. criterion	-4.728
Sum squared residual	0.029	Schwarz criterion	-4.473
Log likelihood	175.866	*F*-statistic	552.392
Durbin-Watson statistic	0.498	Prob (*F*-statistic)	0.000

This implies that raising the lending rates for consumers or firms is likely to discourage borrowing and reduce consumption and investment expenditures. The positive sign of *DE* indicates that an increase in deficits through a decrease in taxes or an increase in government spending or both is expected

to increase real output. The sign of *WE* is positive, indicating that an increase in real wealth such as financial assets is expected to increase real output. The positive sign of *CC* implies that higher consumer confidence is expected to affect real output positively.

Table 5: Error Correction Model for D(Y): 1983:Q2-2000:Q1

C	*D*(*Y*(-1))	*D*(*Y*(-2))	*D*(*EX*(-1)	*D*(*EX*(-2))	*D*(*DR*(-1)	*D*(*DR*(-2))	*D*(*PR*(-1))	*D*(*PR*(-2))
0.004	0.426	0.002	0.011	-0.004	0.000	0.015	0.045	0.016
(2.358)	(3.038)	(0.014)	(0.515)	(0.162)	(0.015)	(0.930)	(1.486)	(0.527)

D(*LR*(-1))	*D*(*LR*(-2))	*D*(*DE*(-1))	*D*(*DE*(-2))	*D*(*WE*(-1))	*D*(*WE*(-2))	*D*(*CC*(-1))	*D*(*CC*(-2))	*CE*
-0.035	-0.014	0.000	0.000	-0.078	0.115	-0.002	0.01	-0.043
(1.272)	(1.444)	(0.291)	(2.175)	(1.203)	(1.678)	(0.121)	(0.759)	(0.894)

R-squared	0.465	Log likelihood	274.853
Adj. R2	0.283	Akaike AIC	-7.554
F-statistic	2.560	Schwarz SC	-6.967

Notes: *D* is the difference operator. *CE* is the error correction term. The figure in parentheses are absolute *t*-statistics.

A test of the equality of the coefficients for *DR* and *PR* is performed. The null hypothesis is $c(DR)+c(PR) = 0$, where $c(DR)$ is the coefficient for *DR* and $c(PR)$ is the coefficient for *PR*. According to the Wald test with a χ^2 distribution, the value of the test statistic is estimated to be 4.666, which means that there is 97 per cent probability that the null hypothesis can be rejected. Therefore, the two coefficients are statistically different and should be treated as two separate variables.

To compare the OLS estimates with the weighted least squares estimates, White's methodology to correct for heteroskedasticity is applied. As shown in table 4, the results are similar to those obtained from OLS. The coefficients for *DR, PR, LR* and *DE* are insignificant at the 10 per cent level. It suggests that when time series data are used in empirical work, the GARCH model along with other methodologies should be considered.

To examine the short-term dynamics between *Y* and the right-hand side variables, the vector error correction (VEC) regression is estimated and presented in table 5. Two lags are chosen based on the Akaike information criterion and the explanatory power. As shown, the value of the adjusted R^2 is 0.284. The *F*-statistic is estimated to be 2.561, which is greater than the critical value of 2.520 with 17 and 50 degrees of freedom at the 1 per cent level. Hence, the overall regression is significant.

5. Summary and conclusions

In this study, the impacts of a weak US dollar and low deposit rates have been examined. The unique features of this paper are to separate the deposit rate from the personal loan rate and the business lending rate, to consider the wealth effect, and to apply GARCH(p,q) process to estimate regression parameters. Several major findings are summarized below. A decrease in the real effective exchange rate partly due to a weak dollar is expected to raise real GDP because the gains in exports and other areas outweigh the losses. The net effect of lower deposit rates is likely to reduce interest income and consumption spending. An increase in deficit spending would increase real output. There are several policy implications. Monetary policy should not be aimed at lowering or raising all the interest rates. According to the findings in this paper, many households have been hurt by the decline in interest income due to relatively low deposit rates. Thus, a further decrease in the federal funds rate or the deposit rate may not help increase consumption spending. Although deficit spending would cause real GDP to rise, rising government debt in the long run may be harmful to the economy. Furthermore, the wealth effect on consumption spending and aggregate demand should be recognized so that the adverse impact of a potential dramatic decline in financial wealth on real output may be better understood.

There may be areas for further research. A limitation of the paper is the use of the reduced-form single equation system in empirical work, which does not take into consideration potential simultaneous relationships among variables such as between interest rates and GDP and between consumer confidence and GDP. If the sample size is large enough, a VAR model may be applied to tackle with the issue of simultaneity. A more general equilibrium model may be considered in that real output and the interest rate are simultaneously determined. Other econometric techniques may be considered to estimate regression parameters.

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Endnote

1. Department of General Business, College of Business and Technology, Southeastern Louisiana University, Hammond, LA 70402, USA. E-mail: yhsing@selu.edu. I gratefully acknowledge valuable comments on earlier versions of the paper from the anonymous referees and conference participants.

2. Another approach is to apply the IS-LM model to find the equilibrium output and interest rate simultaneously (Barth, Iden and Russek, 1984-1985, 1985; Gali, 1992; Dubey and Greanakoplos, 2000; Dohmen, 2002). In the IS-LM model, the quantity of money is an independent variable. Because the Federal Reserve Bank has been using the interest rate as a policy tool, it may be more appropriate to consider the interest rate as a right-hand side variable.

3. Caution needs to be made in performing the cointegration test under GARCH. Kim and Schmidt (1993) showed that these tests have a tendency to over-reject no cointegration and favour cointegration. However, they also indicated that the bias is generally moderate and not very serious.

4. As White (1997) indicated, the GARCH(1,1) process is commonly considered as practical in empirical work.

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