Entrepreneurial Impact of Turbulence in Interest Rates, Inflation Rates, and Exchange Rates

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Abstract

The increased international inter-relation between markets of individual countries, which continues to be intensified by globalization, has facilitated almost instantaneous movements of financial assets to pursue entrepreneurial activities in the geographical domain of choice. The financial market crashes of the 1990's led to the belief that less developed countries are more vulnerable to contagion effects. This belief has far reaching economic implications in relation to, the balance of payments, unemployment, investment, economic growth and development, price stability, a competitive currency, and more generally the overall macro economic performance of an economy. This macro economic performance clearly has the ability to make or break local firms, especially those whose demand derives primarily from the domestic economy. As such, it is relevant to study the interaction between macroeconomic outcomes and entrepreneurial performance against the background of shocks to the economic system. This study uses quarterly Jamaican data from 1993-2005. An Error Correction Model (ECM) was estimated on the premise of cointegration results. A long run relationship was identified between stock market index and both the inflation rate and interest rate. The results indicate that a shock to interest rates and the inflation rate would both result in turbulence in the stock market, with the innovation in inflation being far more adverse. Thus it is extremely critical that policy makers and Monetary Authorities put measures in place so as to maintain price stability, as this could quickly decimate the returns to entrepreneurship.

***Key Words*:** Entrepreneurship, Turbulence, Macroeconomic Shocks, Cointegration, Stock Performance

Introduction

The global economy experienced extraordinary changes in the nineties that affected the economic prospects of both developed and less developed countries when the decade ended. One measure of the returns to entrepreneurial activity is stock prices/ the return on stocks. The relationship between stock market returns and fundamental economic activities in the United States have been well documented. However, the economic role of the stock markets in relatively less developed Caribbean countries like Jamaica is less clear. Thus the need to measure\estimate the likely economic implications of stock market fall out in Jamaica, as a result of turbulence in the following macroeconomic variables: Interest Rate, Inflation Rate and Exchange Rate.

Specifically, how do these less developed markets respond to changes in fundamental economic variables, when compared to the well developed, well organized, and more efficient markets like the U.S. stock market? The purpose of this study is to investigate the relationship between stock market performance and macroeconomic variables in the Jamaican stock market to gain insight into the impact on entrepreneurial outcomes.

Jamaica is selected as a case study for developing countries because of its large volume of both real and financial investment, when compared to many other countries in the Caribbean. However, Jamaica has experienced mediocre economic growth. Jamaica is a leading member of the Caribbean Community with a liberalized financial market; and is in very close proximity to the United States of America. Thus, it is interesting to ascertain the sensitivity or vulnerability of the Jamaican stock market to turbulence in macroeconomic variables, as a result of shocks, and the economic and entrepreneurial implications of such

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occurrences. The significant macroeconomic variables are: exchange rate, interest rate, and inflation rate.

Literature Review

The body of literature on the economic implications of macroeconomics variables like interest rate, inflation and exchange rate on the stock market is overwhelming. This is so to a large degree, as a result of a number of recent financial crises in, Mexico, Argentina and Asia. Gil-Diaz (1998) concluded that the Mexican Financial Crisis of 1994 which saw capital outflows as fast as the large volume of capital inflows which began around 1990, was due to a myriad of reasons. These included: (1) A semi-fixed exchange rate; (2) a sizable current-account deficit resulting to a large extent from a huge credit expansion, and (3) a substantial rise in U.S. interest rates. The entire financial sector including the local stock market collapsed as a result. Desai (2003) pointed out that financial crisis has a contagion effect, which could be seen during the Asian financial crises. The East Asian economies were swept in a capital-outflow which led to financial and currency crisis that began in Thailand in mid-1997. Currencies tumbled at varying rates in Russia in August 1998, Brazil in January 1999, Turkey in early 2001, and Argentina in December 2001.

The relationship between stock market returns and fundamental economic activities in the U.S. are well documented [Fama (1970, 1990, 1991)]. In recent years, numerous studies [Fama (1981), Huang and Kracaw (1984), Chen, Roll, and Ross (1986), Pearce and Roley (1988), Fung and Lie (1990), Chen (1991), and Wei and Wong (1992)] modeled the relation between asset prices and real economic activities in terms of production rates, productivity, growth rate of GNP, unemployment, yield spread, interest rates, inflation, dividend yields, etc. They all supported the Fama (1981) hypothesis, that inflation is negatively related to real economic activity, and the negative relationship between stock returns and inflation reflects positive impact of real variables on stock returns.

However, the economic role of the stock markets in relatively less developed Asian, South American or Caribbean countries (e.g. Korea, Argentina, Jamaica etc.) is less clear. Bergo (2003) indicated that fluctuations in the exchange rate are important in the conduct of monetary policy, to the extent that they can be expected to have an impact on inflation. There are social costs of turbulence in interest rates, exchange rates and inflation rates. According to Frenkel and Mussa (1980); the repercussions include, capital gains and losses for holders of assets denominated in different national monies, inducing wealth holders to alter their behavior and expend resources in order to reduce risk, and interfering with the efficiency of the price system in guiding resource allocation. From the financial crises that have occurred in recent times, one would hope that the monetary authorities in Jamaica are fully capable to manage these macroeconomic variables in an effective way, so as to reduce turbulence.

Data and Methodology

For the purpose of this research, quarterly data covering 13 years from 1993 to 2005 were used. The analysis involved four macroeconomic variables which are all endogenous: interest rate, exchange rate, inflation rate and stock market index. The measurement of stock market performance is the Jamaica Stock Market Index. Inflation was measured by the rate of change in the Jamaican CPI. Interest rates are measured by the Bank of Jamaica six months Treasury bill, while the (US$\JA$) exchange rates were used to capture the level of exchange rate volatility. The relevant data were garnered from the Bank of Jamaica (BOJ), and the Jamaica Stock Exchange (JSE). All variables are non-stationary, when checks were made using the Augmented Dickey–Fuller test (ADF) and the Phillips–Perron (P–P) test. See Tables 1 and 2 in the Appendix. The variables were then tested for the presence of a unit root at first difference using the Augmented Dickey–Fuller (ADF) test. The results showed that all four variables are integrated of order one; I(1). See Table 3 in the Appendix.

The variables were then tested for the presence of cointegration, using both the Augmented Dickey–Fuller (ADF) test on the generated residual series and the Johansen cointegration test. The results for the ADF, captured in Table 3, show that the residuals are stationary; I(0). Cointegration LR tests based on both the maximal eigenvalue and the trace of the stochastic matrix shows the presence of two cointegrating vectors at the 5% level of significance; this means that there exist a long-run relationship between the variables

(JSEI, INT, INF and EXR) included in the cointegrating vector. See Table 4 in the Appendix. A combination of Ordinary Least Squares (OLS) and Error Correction Model (ECM) were used to capture the long run relationship and thus draw inferences. In the literature a number of different methods were used to assess the impact of macroeconomic variables on the stock market, which included: Dynamic Ordinary Least Squares (DOLS), Vector Autoregressive Model (VAR) and Error Correction Model (ECM). The studies in the literature focused on both developed economies like Germany and developing economies like Argentina and Mexico. The data that were used to carry out the analysis varied between quarterly and annual data. In this study the following models were estimated:

OLS Model: $JSEI_t = \alpha_0 + \alpha_1 INT + \alpha_2 INF + \alpha_3 EXR + \varepsilon_t$ (1)

Where: JSEI= Jamaica Stock Exchange Market Index

INT= 6 Months T-bills rate

INF= quarterly inflation rate

EXR= quarterly exchange rate

The variables are stationary at first difference which can now be used to make economic inferences. Equation (2) is the transformed model given below:

Transformed OLS Model: $\Delta JSEI_t = \alpha_0 + \alpha_1 \Delta INT + \alpha_2 \Delta INF + \alpha_3 \Delta EXR + \varepsilon_t$ (2)

Given the Error Correction mechanism that is built in the Johansen procedure, the deviation from long-run equilibrium is corrected through a series of partial short-run adjustments. The ECM specification restricts the long –run behavior of the variable in the system to converge to their long-run relationship while allowing a wide range of short-run dynamics. The Error Correction Model (ECM) was estimated as follows:

$$\Delta JSEI_t = \alpha_1 + \lambda_1 \hat{\varepsilon}_{t-1} + \beta_{11}\Delta JSEI_{t-1} + \beta_{12}\Delta INT_{t-1} + \beta_{13}\Delta INF_{t-1} + \beta_{14}\Delta EXR_{t-1} + \varepsilon_{1t} \quad (3)$$

$$\Delta INT_t = \alpha_2 + \lambda_2 \hat{\varepsilon}_{t-1} + \beta_{21}\Delta INT_{t-1} + \beta_{22}\Delta INF_{t-1} + \beta_{23}\Delta JSEI_{t-1} + \beta_{24}\Delta EXR_{t-1} + \varepsilon_{2t} \quad (4)$$

$$\Delta INF_t = \alpha_3 + \lambda_3 \hat{\varepsilon}_{t-1} + \beta_{31}\Delta INF_{t-1} + \beta_{32}\Delta INT_{t-1} + \beta_{33}\Delta JSEI_{t-1} + \beta_{34}\Delta EXR_{t-1} + \varepsilon_{3t} \quad (5)$$

$$\Delta EXR_t = \alpha_4 + \lambda_4 \hat{\varepsilon}_{t-1} + \beta_{41}\Delta EXR_{t-1} + \beta_{42}\Delta INT_{t-1} + \beta_{43}\Delta INF_{t-1} + \beta_{44}\Delta JSEI_{t-1} + \varepsilon_{4t} \quad (6)$$

Where: ΔINF_t = current changes in inflation rate, ΔINT_t = current changes in interest rate, $\Delta JSEI_t$ = current changes stock market index, ΔEXR_t = current changes in exchange rate, $\hat{\varepsilon}_{t-1}$ = lag of the generated residuals from (1) and λ_i = speed of adjustment parameter.

Note: $\hat{\varepsilon}_{t-1}$ =Resid_OLS in the ECM estimated equations.

Estimation Results and Analysis

From Table 5, based on their respective p-values it can be seen that none of the first differenced variables are contributing significantly to the model with the exception of the constant. This result is contrary to expectations based on market fundamentals. With the exception of inflation the signs on the explanatory variables are as expected. That is, as domestic interest rates increase, expected profitability for firms will decline, as the cost of borrowing increases. The process unfolds as investors dump their stocks on the market, thus driving stock prices down, therefore adversely affecting the returns to entrepreneurs. Stock prices would therefore tumble, as investors reallocate their investments to more attractive markets, like the fixed income market (bond market). Therefore, a negative relationship was expected between interest rates and stock prices. The coefficient for interest rate indicates that, a one unit change in the change of interest rate will bring about approximately a 330 points decline in the value of the stock market index, ceteris paribus. As the interest rate increases, the local currency will increase in value (appreciate) or the exchange rate decreases, thus increasing the future prospect of local firms, and therefore the demand for stocks. Therefore a positive relationship was expected between the value of the local currency and stock prices and by extension the returns to entrepreneurial activities.

From the results it is estimated that, a one unit change in the change of exchange rate will bring about an 80 points decline in the value of the stock market index, ceteris paribus. When the currency appreciates, inflation will decline, thus increasing confidence in the economy and expected profitability will increase. Therefore, a negative relationship was expected between inflation and stock prices/ entrepreneurial returns. The expectation for the inflation rate is that, a one unit change in the change of inflation rate will bring about a 5089 points increase in the value of the stock market index, ceteris paribus. A possible explanation for this relationship may be due to the fact that the Jamaican stock market is not well developed; therefore market fundamentals are not fully operational. Another possible reason might be due to the fact that profit earners are generally the winners in developing economies due to information asymmetry, thus the stock market by and large will still remain buoyant in the wake of inflationary pressures. The value of firms' goods and services will also increase in value as a result of an increase in the cost that consumers have to now pay.

This positive relationship may simply be a matter of the increase in the stock market index in nominal terms. The R^2 is 7.5% which is an indication that the regressors do not efficiently explain the dependent variable. Some lags could have been added to increase this value, at the expense of losing some observations.

From Tables 6 and 9 it can be seen that the speed of adjustment parameter for exchange rates and the stock market index is not significant, with p-values of 0.3956 and 0.0540 respectively. Therefore, if there is a shock in the stock market, exchange rates and the stock market index would not contribute significantly to the system reverting to its long run mean value. However, Tables 7 and 8, paints an entirely different picture with the speed of adjustment parameter both being significant for interest rates and exchange rates. See Tables in the Appendix.

In equation 4, current changes in INT are a function of changes in its own past values, the past values of exchange rate, inflation rate, stock market index and the degree to which the two series (INT and JSEI) are outside their equilibrium in the previous period. Specifically, β_{21} and β_{23} capture any immediate effect that ΔINT_{t-1} and $\Delta JSEI_{t-1}$ have on interest rate. This effect is also described as the short-term or contemporaneous effect. The term (ε_{t-1}) can be considered as deviations from the long-run equilibrium. The long-term effect occurs at a rate driven by the value of λ_2 which is also called the speed of adjustment. This speed of adjustment is a measure of how quickly short-run changes in, stock market value, interest rate and inflation rate respond to the deviations from the long-run equilibrium in the previous period.

Equations 5 would be interpreted in a similar way as equation 4. The speeds of adjustment parameters, as presented in the ECM that were estimated using OLS are -0.00049 and -0.00000434 respectively. These values imply that short-run changes, in the interest rate and inflation rate respond to the deviations from the long-run equilibrium in the previous period at rates of -0.00049 and -0.00000434 respectively. Thus, if deviations between stock market index and inflation (in previous period) were say 30 units, then short-run changes in market index would respond to this disequilibrium at a rate of 0.0001302 in period ***t+1***. It is important to note that the error correction model implies that market index and inflation have an equilibrium relationship, where this deviation (30 units) disturbs the equilibrium, causing market index to be too low. In period ***t*** **+** 2, there would be an increase of 0.003906 in the stock market index. Therefore, it is evident that the largest portion of the movement in stock market value would have occurred in the period ***t+2***. Based on the ECM, inflation has two effects on stock market index: one that occurs immediately and another impact dispersed across future time periods.

Similarly, the speed of adjustment for interest rate is - 0.00049 in equation 4, which means that stock market index would change by 0.00049 multiplied by the deviation (30 units) from the long-run equilibrium in each time period. Thus, if deviations between stock market index and interest rate (in previous period) were say 30 units, then short-run changes in market index would respond to this disequilibrium at a rate of 0.0147 in period ***t+1*** and 0.441 in period ***t+2***. This process will continue until there is equality or equilibrium in the long-run relationship between the two variables. Thus, the short run relationship between the two variables is a positive one. Therefore, with a shock in interest rate, the stock market is expected to adjust much quicker than if there was a shock in inflation. This analysis has been graphically represented by the impulse response function in Figure 5.

Figure 5 captures the impulse response function that traces the effect of a shock in a particular variable on other variables, using a Cholesky one standard deviation innovation. An assessment of the response of stock market index to an innovation in interest rate causes some amount of turbulence in the stock market, initially. However, this will quickly dissipate. On the other hand, a shock in inflation will result in a greater level of turbulence to the stock market as indicated by the graph. Thus it is extremely critical that policy makers and Monetary Authorities put measures in place so as to maintain price stability, as this could quickly precipitate a financial sector crisis.

Conclusion

This empirical study was conducted with the objective of investigating the relationship between entrepreneurial outcomes, measured by stock market performance, and macroeconomic variables in the Jamaican stock market. The research focuses on quarterly data covering 13 years from 1993 to 2005, and involved four macroeconomic variables: interest rate, exchange rate, inflation rate and stock market index. A combination of Ordinary Least Squares (OLS) and Error Correction Model (ECM) were used to capture the long run relationship and thus draw inferences. A long run relationship was identified between stock market index and both inflation rate and interest rate. The results indicate that a shock to interest rate and inflation rate would both result in turbulence in the stock market – and therefore entrepreneurial returns -, with the innovation in inflation being far more adverse. Thus, it is extremely critical that Policy Makers and Monetary Authorities put measures in place so as to maintain price stability, as this could decimate the returns to entrepreneurship. Further research could also be done to ascertain the amount of capital of the Jamaican financial system that is at risk, and the best possible way to hedge against such risk. This is critical especially in light of the ensuing financial crisis unfolding in the United States and Europe.

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Appendix

Figure 1

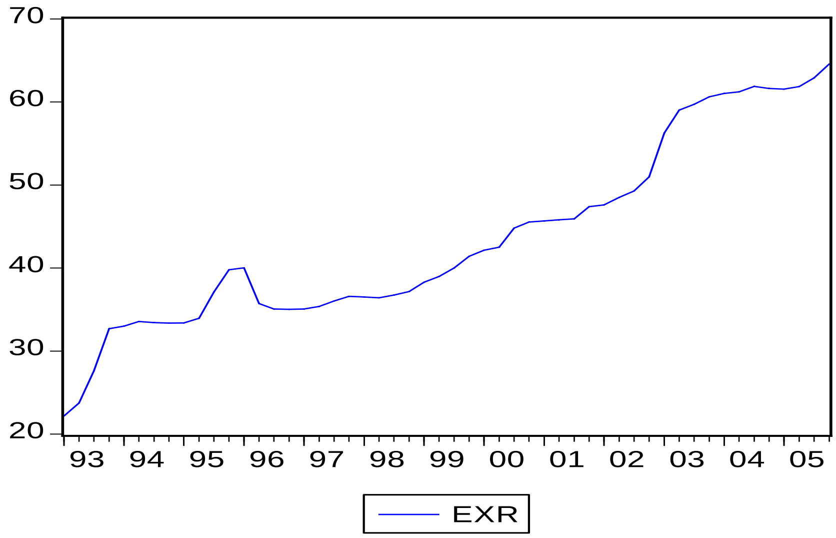

Figure 2

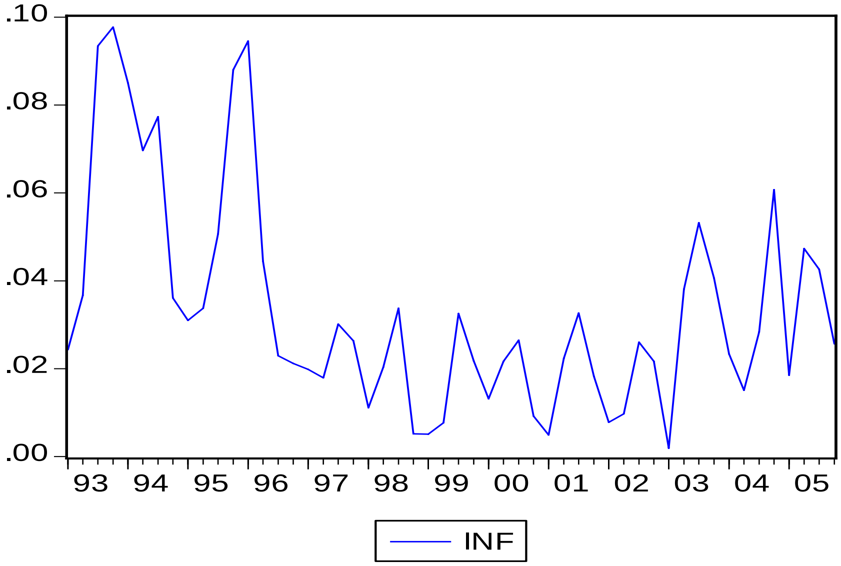

Figure 3

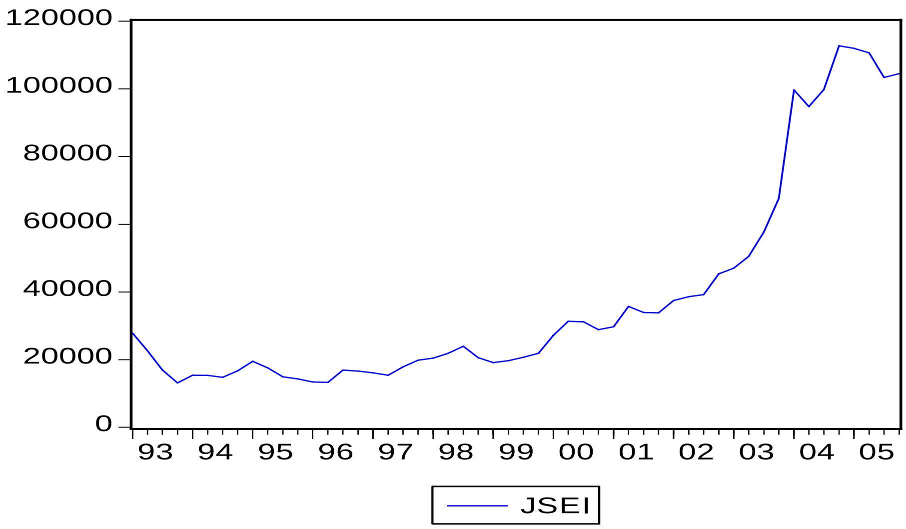

Figure 4

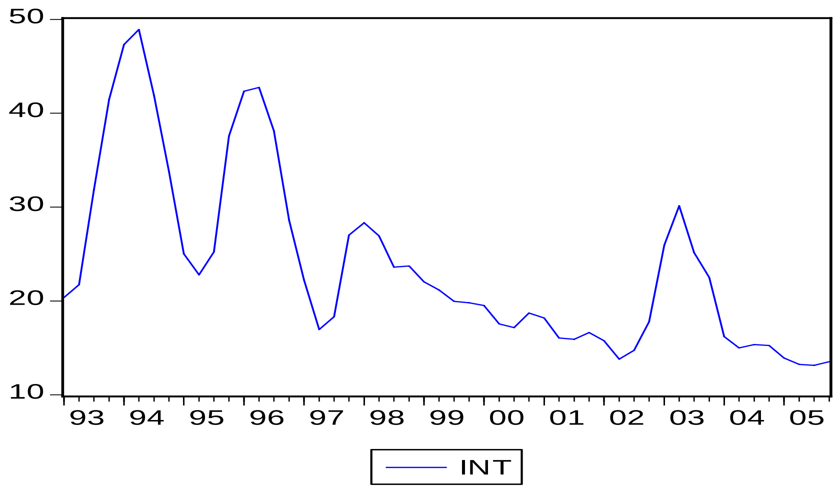

Table 1
Aurgumented Dickey-Fuller Unit Root Test (α =0.05)

Variables	P-value	T-Statistic	Critical Value
EXR	0.9843	1.8755	-1.9475
INF	0.0780	-1.7379	-1.9474
INT	0.0767	-1.7458	-1.9480
JSEI	0.9926	2.1999	-1.9474

Table 2
Phillip-Perron Unit Root Test (α =0.05)

Variables	P-value	T-Statistic	Critical Value
EXR	0.9999	3.7587	-1.94754
INF	0.1313	-1.4682	-1.9474
INT	0.3080	-0.9324	-1.9480
JSEI	0.9835	1.8516	-1.9474

Table 4
Aurgumented Dickey-Fuller Unit Root Test (α =0.05)

Variables	P-value	T-Statistic	Critical Value
EXR(-1)	0.0011	-3.3722	-1.9475
INF(-1)	0.0000	-13.2180	-1.9475
INT(-1)	0.0055	-2.8363	-1.9475
JSEI(-1)	0.0000	-5.8090	-1.9475
Resid01	0.0023	-3.1402	-1.9474

Table 4
Johansen Tests for Cointegration (α =0.05)

Hypothesis		Lmax		Ltrace	
Null	Alternative	Statistic	95% CV	Statistic	95% CV
R=0	R=1	87.671	47.856	41.540	27.584
R<=1	R=2	46.131	29.797	37.873	21.132
R<=2	R=3	8.258	15.495	8.236	14.265
R<=3	R=4	0.0223	3.841	0.0223	3.841

Table 5
Dependent Variable: JSEI-JSEI(-1)

Method: Least Squares
Date: 03/30/08 Time: 18:08
Sample (adjusted): 1993Q2 2005Q4
Included observations: 51 after adjustments
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1526.514	665.9649	2.292184	0.0264
INT-INT(-1)	-329.4693	279.7365	-1.177784	0.2448
INF-INF(-1)	5089.029	36655.33	0.138835	0.8902
EXR-EXR(-1)	-80.27146	628.2527	-0.127769	0.8989

R-squared	0.074849	Mean dependent var	1503.930
Adjusted R-squared	0.015797	S.D. dependent var	5728.180
S.E. of regression	5682.757	Akaike info criterion	20.20345
Sum squared resid	1.52E+09	Schwarz criterion	20.35496
Log likelihood	-511.1879	F-statistic	1.267504
Durbin-Watson stat	1.682504	Prob(F-statistic)	0.296360

Table 6

Dependent Variable: DEXR
Method: Least Squares
Date: 03/30/08 Time: 18:50
Sample (adjusted): 1993Q3 2005Q4
Included observations: 50 after adjustments
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.639411	0.613614	2.671731	0.0106
RESID_OLS	1.95E-05	2.27E-05	0.858094	0.3956
DEXR_1	0.443201	0.135040	3.281991	0.0021
DINT_1	-0.007747	0.046057	-0.168201	0.8672
DINF_1	6.609316	12.88697	0.512868	0.6107
DJSEI_1	-3.86E-05	2.53E-05	-1.528182	0.1338
INT(-1)	-0.045957	0.020926	-2.196175	0.0335

R-squared	0.324316	Mean dependent var	0.816628
Adjusted R-squared	0.230034	S.D. dependent var	1.461701
S.E. of regression	1.282609	Akaike info criterion	3.464847
Sum squared resid	70.73871	Schwarz criterion	3.732530
Log likelihood	-79.62118	F-statistic	3.439864
Durbin-Watson stat	1.849869	Prob(F-statistic)	0.007302

Table 7

Dependent Variable: DINF
Method: Least Squares
Date: 04/21/08 Time: 10:12
Sample (adjusted): 1993Q3 2005Q4
Included observations: 50 after adjustments
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.190160	0.021276	-8.937771	0.0000
DINF_1	0.386512	0.119313	3.239489	0.0024
DINT_1	0.001330	0.000790	1.683050	0.1002
DJSEI_1	-6.06E-07	2.94E-07	-2.062993	0.0456
DEXR_1	0.001914	0.001565	1.222799	0.2286
RESID_OLS	-4.34E-06	4.34E-07	9.997450	0.0000
JSEI(-1)	-3.88E-06	3.61E-07	-10.76124	0.0000
INT(-1)	-0.004181	0.000536	-7.803926	0.0000
EXR(-1)	0.012508	0.001235	10.12597	0.0000
T	-0.003908	0.000572	-6.835880	0.0000

R-squared	0.661175	Mean dependent var	-0.000222
Adjusted R-squared	0.584939	S.D. dependent var	0.020420
S.E. of regression	0.013156	Akaike info criterion	-5.647058
Sum squared resid	0.006923	Schwarz criterion	-5.264654
Log likelihood	151.1765	F-statistic	8.672775
Durbin-Watson stat	2.032429	Prob(F-statistic)	0.000000

Table 8

Dependent Variable: DINT
Method: Least Squares
Date: 03/30/08 Time: 18:44
Sample (adjusted): 1993Q3 2005Q4
Included observations: 50 after adjustments
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	39.40654	4.721891	8.345499	0.0000
RESID_OLS	-0.000493	7.67E-05	-6.425777	0.0000
DINT_1	0.566296	0.095545	5.926994	0.0000
DINF_1	-31.51391	21.03574	-1.498112	0.1418
DJSEI_1	5.87E-05	4.56E-05	1.286162	0.2056
DEXR_1	0.754353	0.389402	1.937208	0.0596
INF(-1)	-53.74139	15.46341	-3.475390	0.0012
EXR(-1)	-1.321135	0.150824	-8.759468	0.0000
JSEI(-1)	0.000508	5.76E-05	8.823324	0.0000

R-squared	0.749976	Mean dependent var	-0.163800
Adjusted R-squared	0.701191	S.D. dependent var	4.676698
S.E. of regression	2.556443	Akaike info criterion	4.876660
Sum squared resid	267.9514	Schwarz criterion	5.220824
Log likelihood	-112.9165	F-statistic	15.37305
Durbin-Watson stat	1.951949	Prob(F-statistic)	0.000000

Table 9

Dependent Variable: DJSEI

Method: Least Squares

Date: 03/30/08 Time: 18:49

Sample (adjusted): 1993Q3 2005Q4

Included observations: 50 after adjustments

Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1131.848	871.3994	1.298886	0.2007
RESID_OLS	-0.157638	0.079612	-1.980081	0.0540
DJSEI_1	0.178032	0.139914	1.272438	0.2099
DINT_1	-17.85762	105.0959	-0.169917	0.8659
DINF_1	-62559.01	26454.83	-2.364748	0.0225
DEXR_1	126.5997	276.7798	0.457402	0.6496

R-squared	0.156962	Mean dependent var	1637.122
Adjusted R-squared	0.061163	S.D. dependent var	5706.004
S.E. of regression	5528.754	Akaike info criterion	20.18548
Sum squared resid	1.34E+09	Schwarz criterion	20.41492
Log likelihood	-498.6370	F-statistic	1.638442
Durbin-Watson stat	1.997266	Prob(F-statistic)	0.169855

Figure 5