Conflict of Exchange Rates

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Econometrics of Exchange Rate

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Conflict between economic interests of two or more countries can take place in the inflation prone floating exchange regime and thus affect monetary policies of each other. This paper tries to examine whether the exchange rates of the currencies of the industrial countries are affecting India's currency and making the Reserve Bank of India (RBI) intervene in the foreign exchange market. It is found that limitation of RBI data is a major factor constraining the progress of research on the above kind of conflict.

1. Introduction

The experiences of the international monetary system since 1973 till now have lead to a floating exchange rate system, whereby the present leading currencies of the world like European Economic and Monetary Union's euro, Japan's yen, Great Britain's pound sterling and International Monetary Fund's SDR (special drawing rights) follow the floating exchange rate system and the currencies of the transition economies follow a mix of fixed and flexible exchange systems. From October 1975 India has pegged rupee against the basket of above five currencies and in August 1994, the final step in a three-year long process since late 1991 towards current account convertibility was taken by acceptance of the obligations under Article VIII of the IMF, under which India is committed to forsake the use of exchange restrictions on current international transactions as an instrument in managing the balance of payments[1]. Economic theory tells that RBI has to intervene in the foreign exchange market by purchase/sale of foreign exchange assets in terms of above five currencies in order to control/prevent fluctuations in the external value of rupee vis-à-vis above five currencies so as to maintain external balance in terms of a sound balance of payment position and internal balance in terms of a suitable trade off between inflation and unemployment[2].

[1] Until very recently rupee had been pegged to a basket of five currencies. Data on the movement of sixth currency are too scarce to facilitate research.

[2] As per economic theory an appreciation in rupee is supposed to make exports more costly and imports more expensive. This phenomenon reduces world demand for India's output and increases India's demand for imports thereby adding to net foreign exchange outflow and at the same time allowing imports to supplant their domestic counterparts in a liberalized trade regime. A depreciation in rupee is supposed to do the reverse adding to net foreign exchange inflow. The experiences of the countries following a floating exchange rate system between 1966 and 1972 show that this system allows international divergence in inflation rates. It is also found that high inflation countries tend to have weaker currencies than their low inflation neighbors. Further, most of the difference in depreciation rates is due to inflation differences, making purchasing power parity a major factor causing long run nominal exchange rate variability. Experiences show that a central bank cannot be indifferent to its currency's value in the foreign exchange market. After 1973 central banks repeatedly intervened in the foreign currency market to alter exchange rates.

2. Issues to be addressed

1. What is the pattern of movement over the years since 1976-77 till 2002-03 of the of rupee values of above currencies?
2. What is the pattern of changes over the years during the above period of RBI's net foreign exchange assets position?
3. Do the changes in values of industrial countries' currencies in terms of rupee make the RBI intervene in the foreign exchange market?

(i). Objective of the paper

Intellectual exercise in form of application of multivariate regression model to the time series data is the objective of the paper. In course of going through successive steps of analysis starting from test of stationarity of time series data up to examination of residuals with a view to detecting heteroscedasticity problem, the paper seeks some meaningful implications of limitation of RBI data on its foreign exchange market intervention facing the economists (Ghosh 2002).

(ii). Collection and nature of data

Data is collected from RBI publications and therefore it is a secondary data[3]. RBI publishes data on its international operations in gold, SDR and other foreign currencies in form of a composite variable called 'Net Foreign Exchange Assets (NFEA)' and the exchange rates of the five foreign currencies to which rupee is linked in form rupee values of these individual currencies. Exchange rate of a currency, say dollar, in terms of rupee is denoted by D/R, which means the value of dollar in terms of rupee. We have taken data on NFEA and these five exchange rates – dollar/rupee (D/R), mark/rupee

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[3] Any time series data has an underlying stochastic process. A stochastic process is called stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the lag between the two time periods and not on the time of calculation of covariance.

There are two key concepts in time series analysis:

i. Trend stationary process (TSP): If in the regression $Y_t = a + bt + u_t$, error term u_t is stationary then $Y_t = a + bt + u_t$ represents a TSP.

ii. Difference stationary process (DSP): If Y_t is generated as $Y_t - Y_{t-1} = c + u_t$, where c is a constant and u_t is stationary then the process is called a DSP.

The consequence of a non-stationary time series data is that it makes least square estimators inconsistent and diagnostic statistics like *t* and *F* statistics do not have their standard limiting distributions. As a consequence of this the regression coefficient of an explanatory variable may appear significantly different from 0 though it is not truly a determinant of the dependent variable. Stationarity is checked through, among others, Augmented Dicky-Fuller Unit Root Test (Gujarati 1995).

(M/R), yen/rupee (Y/R), SDR/rupee (SDR/R) and pound sterling/rupee (PS/R). After January 1, 1999, euro has replaced mark. Except mark/rupee, all other five variables are found non-stationary at the first difference.

(iii). Research methodology

The methodology of research is econometric modeling supplemented by software packages. The stationarity test is conducted in 'EViews' and rest of the analysis is conducted in 'Analysis Tool Pack'.

3. Steps in analysis of data

Step 1

We conduct augmented Dickey-Fuller unit root tests for first and second differences in all of exchange rate variables and NFEA variable. NFEA data is nonstationary in the first difference unit root test at 1% level of significance because the computed value of $|\tau|$ is less than 1% and 5% critical Mackinnon values for rejection of the hypothesis that the series is stationary, whereas it is more than all critical Mackinnon values in the second difference. For dollar/rupee the computed $|\tau|$ value is below 1% and 5% critical values, but above 10% critical values and above all critical values for 2nd difference unit root test. For pound/rupee and yen/rupee, the computed $|\tau|$ values are below 1% critical value but above 5% and 10% critical values and above all critical values for 2nd difference unit root test. For SDR/rupee, the computed $|\tau|$ value is above all critical values in the 1st difference unit root test. For mark/rupee and balance of payments, the computed $|\tau|$ values are above all critical values in the first difference unit root test. So second difference unit root test is not required for mark/rupee. In short at all levels of significance NEFA is stationary at first difference, SDR stationary at first difference, Y/R stationary at second difference, PS/R stationary at second difference, M/R stationary at first difference, D/R stationary at second difference.

Step 2

There are three preconditions for success of the regression model:

1. If we work with time series data it should be stationary. A stationary series is free of autocorrelation. We deduct the value of each period value from the value of the preceding period for all variables except mark/rupee in order to make them stationary. This takes care of autocorrelation problem also. We do the same for mark/rupee also in order to conform it to the proposed multivariate regression model.
2. The independent variables should be free of multicollinearity. In order to avoid the problem of multicollinearity we check the correlation matrix between the exchange rates and it is found strong positive correlation exists between exponentials of changes in all exchange rates except between those in dollar/rupee and mark/rupee. So we take only these two variables for as independent variables. We could have taken balance of payments variable as an independent variable, but theoretically it is influenced by exchange rate fluctuations and thus could lead to multicollinearity problem if included in the set of independent variables along with the exchange rates (Delurgio 1998).

3. The residuals should be free of heteroscedasticity. They should not show any patterns when plotted against the values of independent variables and the estimated values of the dependent variable. Existence of heteroscedasticity of the residuals problem can be examined after estimating the model.

Step 3

Again there is a difference between the levels of the units of the dependent variable - change in NFEA and those of the independent variables - changes in all exchange rates. In order to wipe out this difference we apply exponential operator to the values of all independent variables.

Step 4

We propose the model:

$\Delta NFEA = c + m_1 e^{\Delta(D/R)} + m_2 e^{\Delta(M/R)} + u$, u is the error tem, c is the constant term, m_1 and m_2 are coefficient parameters, $e^{\Delta(D/R)}$ is the exponential value of the change in dollar/rupee and $e^{\Delta(M/R)}$ is the exponential value of the change in mark/rupee.

4. Result, interpretations and conclusion

Following are the results of the analysis and followed by interpretations and conclusion:

1. There is no correlation between dollar/rupee and mark/rupee, because, perhaps, the European Economic and Monetary Union's monetary policy maintains independence of the monetary policy of United States, while Japan and Great Britain link their currencies to dollar and IMF to gold to which, dollar is in turn linked (Krugman 2000).
2. When plotted against independent variables and the estimated dependent variable, residuals do not exhibit any patterns and hence can be inferred to be free of heteroscedasticity problem.
3. Changes in the exchange rates dollar/rupee and mark/rupee could not explain changes in NFEA, perhaps because, NFEA includes information not only on RBI's intervention in dollar and mark, but also on the same in pound sterling, yen and SDR. RBI does not publish data separately on its interventions in dollar and mark. The results of regression analysis are displayed in the appendix.

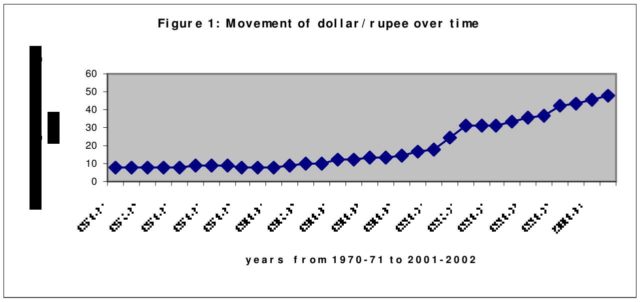
We conclude that unless RBI publishes details of its foreign exchange operations in terms of net assets in individual foreign currencies, it would be difficult to ascertain the impact, if any, of monetary policies of US and EMS on the monetary policy of RBI.

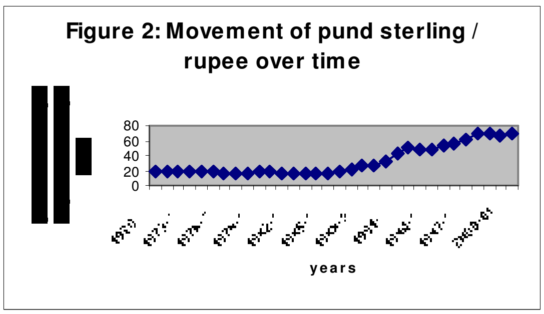
9. References

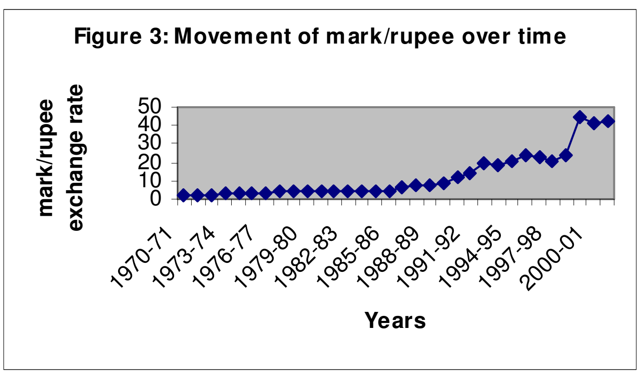
1. Ghosh S (2002): 'RBI Intervention in the Forex Market', *Economic and Political Weekly*, June 15, Volume 37, No 24, p 2333-48
2. Delurgio S A (1998): *Forecasting Principles and Applications*, Irwin McGraw-Hill, Boston, 1st edition, Chapter 3
3. Gujarati D N (1995): *Basic Econometrics*, McGraw-Hill, New York, 3rd Edition, Chapter 21
4. Krugman P R (2000): *International Economics, Theory and Policy*, Addision Wesley Longman, Singapore, 5th edition, Chapters 18-20

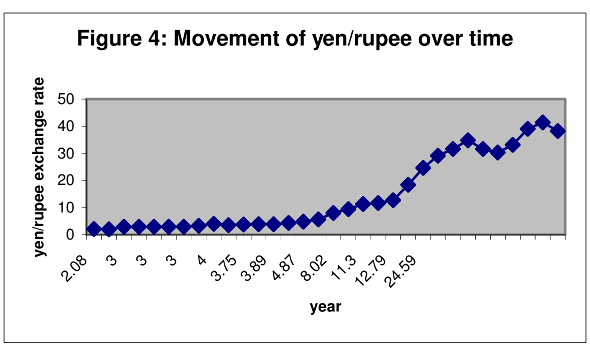
5. Reserve Bank of India (2003): *Handbook of Statistics on Indian Economy*, Reserve Bank of India, Mumbai

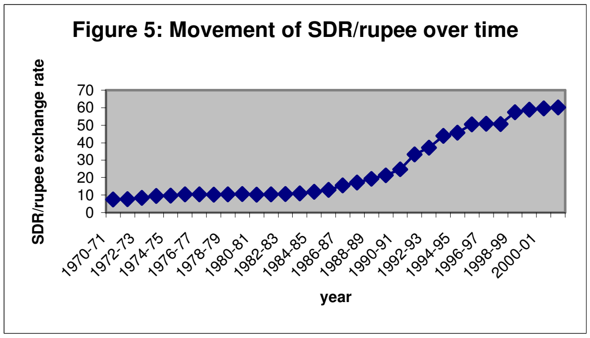
Appendix











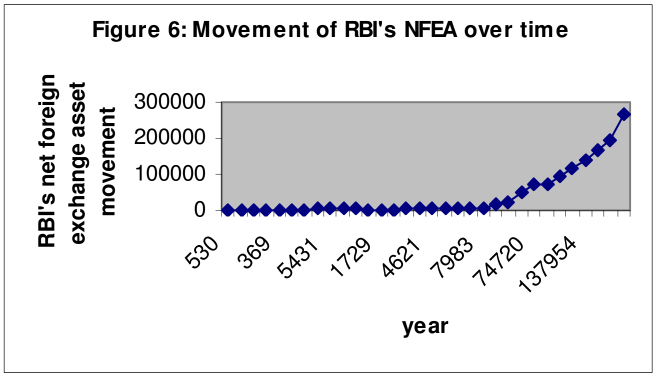


Table 1: Modified RBI Data

Year	EXP(Change in NFEA)	EXP(Change in dollar/rupee)	EXP(Change in PS/R)	EXP(Change in M/R)	EXP(Change in Y/R)	EXP(Change in SDR/R)
1970-71						
1971-72	78	0.91879	1.15998	1.49182	0.96079	1.18946
1972-73	-39	1.22373	1.27354	1.55659	2.6117	2.20141
1973-74	92	1.12468	1.76526	0.95839	1	2.54798
1974-75	-292	1.15986	1.20226	1	1	1.25282
1975-76	555	2.0995	1.2893	0.66584	1	2.09782
1976-77	1675	1.34313	1.20322	0.05961	1	0.9859
1977-78	1933	0.67591	1.22753	0.8658	1.39097	0.82737
1978-79	899	0.6983	1.46844	1.71018	1.95424	1.31128
1979-80	-43	0.8788	1.28621	5.41515	0.65705	1.06396
1980-81	-613	0.82837	0.75262	2.33778	1.1853	0.72921
1981-82	-2069	2.88377	0.72123	0.24793	1.20925	1.17081
1982-83	-977	2.00913	1.1044	0.37757	0.95123	1.25533
1983-84	-105	1.96207	0.98039	0.48763	1.63232	1.45893
1984-85	1275	4.70488	1.04865	0.5766	1.63232	2.69743
1985-86	842	1.41383	1.76403	7.24202	2.117	2.69231

1986-87	880	1.72168	5.70704	9.25811	11.0232	12.4784
1987-88	795	1.20635	3.0144	20.3891	4.01485	5.33133
1988-89	785	4.55352	1.91363	33.4048	6.61937	8.50879
1989-90	-133	8.73642	2.83715	3.75092	1.43333	8.21942
1990-91	1915	3.64589	10.4114	503.257	3.09566	32.2881
1991-92	10855	686.015	24.2811	11802.9	284.291	5374.39
1992-93	3809	480.631	143.008	9611.35	468.717	40.813
1993-94	28775	2.04766	0.42853	0.01134	91.8356	849.629
1994-95	23298	1.03365	4.31199	5.02638	12.4797	6.71605
1995-96	-628	7.77723	24.4737	34.1752	24.7395	108.419
1996-97	20725	7.76868	0.62195	55.2573	0.0386	1.50531
1997-98	21073	5.28514	0.14042	105.573	0.27557	0.80872
1998-99	22064	135.071	24.9756	5046.75	17.0321	933.929
1999-2000	27926	3.53283	8.9E+08	1.35053	374.84	4.1396
2000-01	31295	10.5034	0.0366	0.10038	10.4291	1.84485
2001-02	66794	7.44468	2.00953	2.15265	0.03971	1.95248

Table 2: RBI Data

Year	NFEA	D/R	PS/R	M/R	Y/R	SDR/R
1970-71	530	7.5578	18	2.049	2.08	7.5
1971-72	608	7.4731	18.4	2.1974	2.04	7.6735
1972-73	569	7.675	18.8425	2.4392	3	8.4626
1973-74	661	7.7925	18.8	3.0075	3	9.3979
1974-75	369	7.9408	18.8	3.1917	3	9.6233
1975-76	924	8.6825	18.3933	3.4458	3	10.3642
1976-77	2599	8.9775	15.5733	3.6308	3	10.35
1977-78	4532	8.5858	15.4292	3.8358	3.33	10.1605
1978-79	5431	8.2267	15.9658	4.22	4	10.4315
1979-80	5388	8.0975	17.655	4.4717	3.58	10.4935
1980-81	4775	7.9092	18.5042	4.1875	3.75	10.1777
1981-82	2706	8.9683	17.1096	3.8607	3.94	10.3354
1982-83	1729	9.666	16.1356	3.96	3.89	10.5628
1983-84	1624	10.34	15.4174	3.9402	4.38	10.9405
1984-85	2899	11.8886	14.8668	3.9877	4.87	11.9328
1985-86	3741	12.2349	16.8467	4.5553	5.62	12.9232
1986-87	4621	12.7782	19.0722	6.297	8.02	15.4472
1987-88	5416	12.9658	22.0872	7.4004	9.41	17.1208
1988-89	6201	14.4817	25.5959	8.0494	11.3	19.2619
1989-90	6068	16.6492	26.9179	9.0922	11.66	21.3684

1990-91	7983	17.9428	33.139	11.4351	12.79	24.8431
1991-92	18838	24.4737	42.5151	14.6248	18.44	33.4325
1992-93	22647	30.6488	51.6858	19.5877	24.59	37.1415
1993-94	51422	31.3655	47.2064	18.7403	29.11	43.8863
1994-95	74720	31.3986	48.8211	20.2017	31.6341	45.7908
1995-96	74092	33.4498	52.3526	23.3993	34.8425	50.4768
1996-97	94817	35.4999	56.3646	22.9244	31.5879	50.8858
1997-98	115890	37.1648	61.024	20.9613	30.299	50.6735
1998-99	137954	42.0706	69.5505	24.1792	33.1341	57.5129
1999-2000	165880	43.3327	69.851	44.7909	39.0606	58.9335
2000-01	197175	45.6844	67.5522	41.4832	41.4052	59.5459
2001-02	263969	47.6919	68.3189	42.1811	38.179	60.215

Table 3: Correlation Matrix

	Column 1	*Column 2*	*Column 3*	*Column 4*	*Column 5*
Column 1	1				
Column 2	0.982628	1			
Column 3	-0.0518	-0.05841	1		
Column 4	0.716813	0.707145	0.537714	1	
Column 5	0.805832	0.757667	-0.04458	0.394724	1

Column 1: EXP(Change in dollar/rupee)
Column 2: EXP(Change in PS/R)
Column 3: EXP(Change in Mark/Rupee)
Column 4: EXP(Change in Yen/Rupee)
Column 5: EXP(Change in SDR/Rupee)

Table 4

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.24134
R Square	0.05825
Adjusted R Square	-0.009
Standard Error	15197.9
Observations	31

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	4E+08	2E+08	0.86589	0.43164

Residual	28	6.5E+09	2.3E+08		
Total	30	6.9E+09			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	7670.15	2907.23	2.6383	0.01345	1714.94	13625.3	1714.94	13625.3
X Variable 1	3.89849	18.7615	0.20779	0.8369	-34.533	42.3297	-34.533	42.3297
X Variable 2	2.3E-05	1.7E-05	1.30848	0.20135	-1E-05	5.8E-05	-1E-05	5.8E-05

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	7673.73	-7595.7
2	7674.92	-7713.9
3	7674.53	-7582.5
4	7674.67	-7966.7
5	7678.33	-7123.3
6	7675.38	-6000.4
7	7672.78	-5739.8
8	7672.87	-6773.9
9	7673.57	-7716.6
10	7673.37	-8286.4
11	7681.39	-9750.4
12	7677.98	-8655
13	7677.79	-7782.8
14	7688.49	-6413.5
15	7675.66	-6833.7
16	7676.86	-6796.9
17	7674.85	-6879.8
18	7687.9	-6902.9
19	7704.2	-7837.2
20	7684.36	-5769.4
21	10344.6	510.431
22	9543.88	-5734.9
23	7678.13	21096.9
24	7674.18	15623.8
25	7700.47	-8328.5

26	7700.43	13024.6
27	7690.75	13382.3
28	8196.72	13867.3
29	27926	0.00084
30	7711.09	23583.9
31	7699.17	59094.8

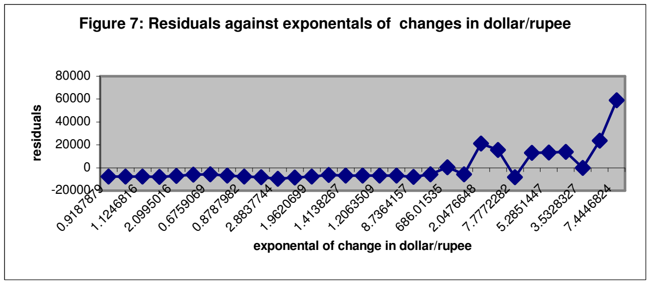


Figure 7: Residuals against exponentals of changes in dollar/rupee

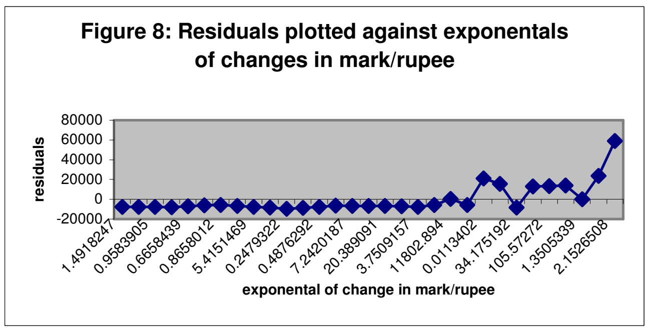


Figure 8: Residuals plotted against exponentals of changes in mark/rupee

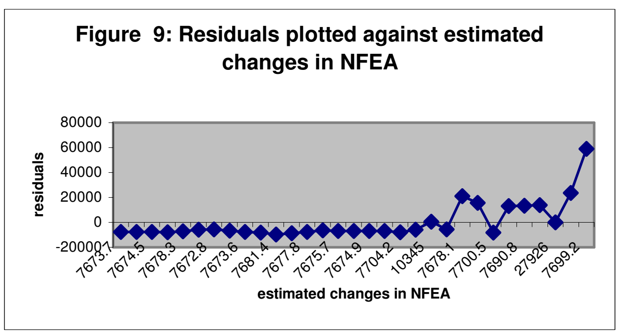


Figure 9: Residuals plotted against estimated changes in NFEA

ADF test of first difference with intercept for NEFA

ADF Test Statistic	0.37948580 0486	1% Critical Value*	-3.6660666 1797
		5% Critical Value	-2.9626554 3832
		10% Critical Value	-2.6200111 5799

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NFEA,2)
Method: Least Squares
Date: 10/06/05 Time: 10:56
Sample(adjusted): 1971-72 to 2001-02
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NFEA(-1))	0.0674732289111	0.17780172229	0.379485800486	0.707190108103
C	1781.59089669	2212.3309012	0.805300371533	0.42743235404

R-squared	0.00511687835062	Mean dependent var	2223.86666667
Adjusted R-squared	-0.0304146617083	S.D. dependent var	10146.5281262
S.E. of regression	10299.6739886	Akaike info criterion	21.3819525725
Sum squared resid	2970331959.63	Schwarz criterion	21.4753657313
Log likelihood	-318.729288588	F-statistic	0.144009472771
Durbin-Watson stat	2.19314315459	Prob(F-statistic)	0.707190108103

ADF test of second difference with intercept for NEFA

ADF Test Statistic	-5.7674718976	1% Critical Value*	-3.67524204413
		5% Critical Value	-2.96645422271
		10% Critical Value	-2.62201324541

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NFEA,3)
Method: Least Squares

Sample(adjusted): From 1973-74 to 2001-02
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NFEA(-1),2)	-1.35604584199	0.23511962712	-5.7674718976	3.9127574434e-06
C	2687.85113964	1889.95388104	1.4221781635	0.166424899853

R-squared	0.551969334394	Mean dependent var	1228.13793103
Adjusted R-squared	0.53537560	S.D. dependent var	14796.863

	6039		9552
S.E. of regression	10086.0399647	Akaike info criterion	21.3421642669
Sum squared resid	2746661458.55	Schwarz criterion	21.4364605311
Log likelihood	-307.461381871	F-statistic	33.2637320897
Durbin-Watson stat	1.73053350255	Prob(F-statistic)	3.9127574434e-06

ADF test of first difference with intercept for D/R

ADF Test Statistic	-3.241432	1% Critical Value*	-3.6661
		5% Critical Value	-2.9627
		10% Critical Value	-2.6200

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_R01,2)
Method: Least Squares

Sample(adjusted): From 1972-73 to 2001-02
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(D_R01(-1))	-0.537575	0.165845	-3.241432	0.0031
C	0.752937	0.356094	2.114432	0.0435

R-squared	0.272857	Mean dependent var	0.069740
Adjusted R-squared	0.246888	S.D. dependent var	1.811502
S.E. of regression	1.572059	Akaike info criterion	3.806990
Sum squared resid	69.19832	Schwarz criterion	3.900403
Log likelihood	-55.10484	F-statistic	10.50688
Durbin-Watson stat	1.959254	Prob(F-statistic)	0.003066

ADF test of second difference with intercept for D/R

ADF Test Statistic	-6.5569696395	1% Critical Value*	-3.67524204413
		5% Critical Value	-2.96645422271
		10% Critical Value	-2.62201324541

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(D_R01,3)
Method: Least Squares
Date: 10/06/05 Time: 10:58
Sample(adjusted): 1972-73 to 2001-02
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(D_R01(-1),2)	-1.22918024126	0.187461633779	-6.5569696395	4.94530774691e-07
C	0.081516370338	0.339636160077	0.240010870219	0.812134716255

R-squared	0.614251828256	Mean dependent var	-0.0217517241379
Adjusted R-squared	0.599964858932	S.D. dependent var	2.88865992097

S.E. of regression	1.82702919659	Akaike info criterion	4.10973165268
Sum squared resid	90.1269635002	Schwarz criterion	4.20402791682
Log likelihood	-57.5911089639	F-statistic	42.9938508533
Durbin-Watson stat	2.184118596	Prob(F-statistic)	4.94530774691e-07

ADF test of first difference with intercept for M/R

ADF Test Statistic	-5.702266	1% Critical Value*	-3.6661
		5% Critical Value	-2.9627
		10% Critical Value	-2.6200

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(M_R01,2)
Method: Least Squares

Sample(adjusted): From 1972-73 to 2001-02
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(M_R01(-1))	-1.073543	0.188266	-5.702266	0.0000
C	1.429460	0.776743	1.840325	0.0763

R-squared	0.537311	Mean dependent var	0.018317
Adjusted R-squared	0.520787	S.D. dependent var	5.825472
S.E. of regression	4.032697	Akaike info criterion	5.691088
Sum squared resid	455.3540	Schwarz criterion	5.784501
Log likelihood	-83.36632	F-statistic	32.51583
Durbin-Watson stat	2.028368	Prob(F-statistic)	0.000004

ADF test of first difference with intercept for PS/R

ADF Test Statistic	-3.47575443815	1% Critical Value*	-3.66606661797
		5% Critical Value	-2.96265543832
		10% Critical Value	-2.62001115799

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PS_R01,2)
Method: Least Squares

Sample(adjusted): From 1972-73 to 2001-02
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PS_R01(-1))	-0.601620968718	0.173090757539	-3.47575443815	0.00167896972658

C	1.0059447522	0.639760188813	1.57237785313	0.127096025157

R-squared	0.301412350619	Mean dependent var	0.0122233333333
Adjusted R-squared	0.276462791713	S.D. dependent var	3.6852884502
S.E. of regression	3.13474285376	Akaike info criterion	5.18731182106
Sum squared resid	275.145157258	Schwarz criterion	5.28072497984
Log likelihood	-75.8096773159	F-statistic	12.0808689143
Durbin-Watson stat	1.88930032311	Prob(F-statistic)	0.00167896972658

ADF test of second difference with intercept for PS/R

ADF Test Statistic	-6.36182537571	1%	Critical Value*	-3.67524204413
		5%	Critical Value	-2.96645422271
		10%	Critical Value	-2.62201324541

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PS_R01,3)
Method: Least Squares

Sample(adjusted): From 1973-74 to 2001-02
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PS_R01(-1),2)	-1.21209814915	0.190526787136	-6.36182537571	8.20134464509e-07
C	-0.00855898223903	0.693723207787	-0.0123377481724	0.990246865583

R-squared	0.599838880971	Mean dependent var	0.10424137931
Adjusted R-squared	0.585018098785	S.D. dependent var	5.79733964582
S.E. of regression	3.73459337912	Akaike info criterion	5.53962702682
Sum squared resid	376.574068099	Schwarz criterion	5.63392329095
Log likelihood	-78.3245918888	F-statistic	40.4728221111
Durbin-Watson stat	2.12727921642	Prob(F-statistic)	8.20134464509e-07

ADF test of first difference with intercept for Y/R

ADF Test Statistic	-2.87309610558	1%	Critical Value*	-3.66606661797
		5%	Critical Value	-2.96265543832
		10%	Critical Value	-2.62001115799

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y_R01,2)
Method: Least Squares

Sample(adjusted): From 1972-73 to 2001-02
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Y_R01(-1))	-0.5170000287	0.179945261036	-2.87309610558	0.00766995873675
C	0.571497650955	0.444663441943	1.28523642164	0.209239376285

R-squared	0.22768594155	Mean dependent var	-0.106206666667
Adjusted R-squared	0.200103296606	S.D. dependent var	2.30844762974
S.E. of regression	2.06460502445	Akaike info criterion	4.35209540159
Sum squared resid	119.352629396	Schwarz criterion	4.44550856036
Log likelihood	-63.2814310238	F-statistic	8.25468123188
Durbin-Watson stat	1.42002396945	Prob(F-statistic)	0.00766995873675

ADF test of second difference with intercept for Y/R

ADF Test Statistic	-4.15680643185	1% Critical Value*	-3.67524204413
		5% Critical Value	-2.96645422271
		10% Critical Value	-2.62201324541

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y_R01,3)
Method: Least Squares

Sample(adjusted): From 1973-74 to 2001-02
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Y_R01(-1),2)	-0.885990913239	0.213142210917	-4.15680643185	0.000291947216954
C	-0.15372641	0.44046072819	-0.349012763	0.729786936129

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R-squared	0.39023067854	Mean dependent var	-0.226579310345
Adjusted R-squared	0.367646629597	S.D. dependent var	2.980452424
S.E. of regression	2.37007512694	Akaike info criterion	4.63019244446
Sum squared resid	151.665914898	Schwarz criterion	4.72448870859
Log likelihood	-65.1377904446	F-statistic	17.2790397118
Durbin-Watson stat	1.73924478611	Prob(F-statistic)	0.000291947216954

ADF test of first difference with intercept for SDR/R

ADF Test Statistic	-3.68720068753	1% Critical Value*	-3.66606661797
		5% Critical Value	-2.96265543832
		10% Critical Value	-2.62001115799

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDR_R01,2)
Method: Least Squares

Sample(adjusted): From 1972-73 to 2001-02
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SDR_R01(-1))	-0.649374403338	0.176115828339	-3.68720068753	0.000965581294034
C	1.14309584196	0.501015044308	2.2815599151	0.0303201081245

R-squared	0.326849433445	Mean dependent var	0.01652
Adjusted R-squared	0.302808341782	S.D. dependent var	2.60465266258
S.E. of regression	2.17483297038	Akaike info criterion	4.45612126099
Sum squared resid	132.437156574	Schwarz criterion	4.54953441976
Log likelihood	-64.8418189148	F-statistic	13.5954489102
Durbin-Watson stat	2.25303861	Prob(F-statistic)	0.0009655

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