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EXCHANGE RATE CONVERGENCE AND MARKET EFFICIENCY

by

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ABSTRACT

The objective of this paper is to examine the market efficiency hypothesis for five major exchange rates of the Australian dollar using multivariate cointegration techniques. The conclusion is that cointegrated relationships exist in foreign exchange markets when interdependence among exchange rates is accounted for.

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1. Introduction

This study investigates firstly the market efficiency hypothesis for five major exchange rates of the Australian dollar (henceforth, A$) before and after the float by means of the cointegration methodology developed by Johansen and Juselius (1990a), and then, if exchange rate convergence exists, it examines which spot rate has borne the burden of adjustment to equilibrium.

In a recent article, MacDonald and Taylor (1989) provided evidence in favour of the hypothesis that foreign exchange markets are efficient, since non-cointegration between a number of US bilateral exchange rates could not be rejected.

The present study argues that foreign exchange markets involve the simultaneous determination of several exchange rates through international arbitrage, and therefore testing the efficiency hypothesis in a bivariate framework is incorrect. The other problem with testing the concept of efficiency in a bivariate framework is the interpretation of nonrejection of the *null hypothesis of noncointegration being regarded as equivalent* to the market efficiency hypothesis. This paper tries to remedy these problems by using a multivariate procedure for testing the market efficiency.

The rest of the paper is organized as follows. In Section 2, methodological and theoretical issues are presented. Section 3 reports and discusses the results. Concluding remarks are given in Section 4.

2. Methodological and Theoretical Issues

It is an empirical fact that many macroeconomic time series are characterised by nonstationarities. Under nonstationarity, the classical t and F-statistics are inappropriate to test theoretical restrictions because the limiting distribution of the asymptotic variance of the parameter estimates is not finitely defined [see Fuller (1985)]. In order to test whether a time series contains a unit root, i.e., it is integrated of order one (I(1)), the parametric tests developed by Fuller (1976), and Dickey and Fuller (1981) are used. Recently Phillips (1987) and Perron (1988) have proposed nonparametric tests which allow for serial correlation and heteroscedasticity. These tests were also conducted in this study.

The long run linkage between a number of series can be looked at from the viewpoint of cointegration [see Engle and Granger (1987)]. Let x(t) be a vector of n-component time series each integrated of the same order k. Then x(t) is said to be cointegrated of order k;p, if there exists a vector λ such that:

$$s(t)=\lambda' x(t)$$

is *I(k-p), p>0. Stationarity of s(t) implies that the n elements of x(t) do not drift away from* one another over the long run, obeying thus an equilibrium relationship. If λ exists, it may not be unique as there can be several equilibrium relationships. If the number of variables to be tested for cointegration is greater than two, the testing procedure developed by Engle and Granger is not applicable, since it does not address the possibility that more than one cointegrating vector may be present. Recent advances in cointegration theory [Johansen and Juselius (1990a)] have developed a maximum likelihood (ML) testing procedure on the number of cointegrating vectors which also allows for inference on parameter restrictions. The ML method uses the interim multiplier form

$$\Delta x(t)=\sum_{i=1}^{q-1}\Pi_i \Delta x(t-i)-\Pi_q x(t-q)+\mu+v(t) \tag{1}$$

of the vector autoregressive (VAR) representation of the system, where x(t) is a nx1 vector of variables of interest and Π_q is a square nxn matrix of rank r≤n, μ is a nx1 vector of constant terms, and v(t) is a nx1 vector of residuals. The testing procedure involves the

null hypothesis H_2: $\Pi_q=\alpha\beta'$; i.e., there are at most r cointegrating vectors $\beta_1,\beta_2,\ldots,\beta_r$ which provide r stationary linear combinations $\beta' x(t-q)$.

The testing procedure is based on regressing the n-element vectors $\Delta x(t)$ and x(t-q) on $\Delta x(t-i)$, i=1,...,q-1, and possibly on a constant and seasonal dummies, and obtaining the associated n-element residual vectors $R_0(t)$ and $R_q(t)$. The test statistic for the number of cointegrating vectors is obtained by solving the eigenvalue problem

$$|\lambda S_{qq} - S_{q0}S_{00}^{-1}S_{0q}| = 0$$

where $S_{ij} = T^{-1}\sum_{t=1}^{T} R_{it}R_{jt}'$, i,j=0,q, and T denotes the number of observations.[1]

The likelihood ratio (LR) statistic for the hypothesis H_2:$\Pi_q=\alpha\beta'$

$$-2\ln(Q{:}H_2|H_1)=-T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}_i) \tag{2}$$

is a test that there are at most r cointegrating vectors versus the general alternative (trace), where λ_i corresponds to the n-r smaller eigenvalues. The nxr matrix of cointegrating vectors Φ can be obtained as the r, n-element eigenvectors corresponding to λ_i.

The LR statistic for testing $H_2(r)$ in $H_2(r+1)$ is given by:

$$-2\ln(Q{:}r|r+1)=-T\ln(1-\hat{\lambda}_{r+1}) \tag{3}$$

The LR statistic for testing the hypothesis for zero loading factors H_4:$\alpha=A\Psi$ is

[1] *The calculation of the eigenvectors of $S_{q0}S_{00}^{-1}S_{0q}$ with respect to S_{qq} can be* transformed into a standard eigenvalue problem by using Choleski decomposition $S_{qq}=CC'$, since the eigenvalues that solve $|\lambda S_{qq}-S_{q0}S_{00}^{-1}S_{0q}|$ also solve $|\lambda I-C^{-1}S_{q0}S_{00}^{-1}S_{0q}C'^{-1}|=0$. Premultiplying the eigenvectors *of the standardized problem by C'^{-1}, one can obtain* the original eigenvectors normalized such that $E'S_{qq}E=I$. The calculations of the eigenvectors have been performed using the computer package RATS 3.0, VAR Econometrics, Inc/Doan Associates.

given by:

$$-2\ln(Q{:}H_4|H_2)=T\sum_{i=1}^{r}\ln[\frac{(1-\hat{\lambda}_{4,i})}{(1-\hat{\lambda}_i)}] \quad (4)$$

which is asymptotically distributed as χ^2 with r(n-k) degrees of freedom; k denotes the restrictions on matrix α.

Let $x(t) = (x^1(t) \ldots x^5(t))'$ be a 5-dimension vector of spot rates. The weak form of market efficiency for the spot rate $x^1(t)$ requires that there is no difference between its expected value $(E(s^1(t))$ conditional on two different information sets [see Fama (1970)]. That is,

$$E(s^1(t)\,|\,\Omega(t-1))=E(s^1(t)\,|\,I(t-1)) \quad (5)$$

where $\Omega(t-1)=\{s^1(t-1),\ldots\}$, and $I(t-1)=\{s^1(t-1),\ldots,s^j(t-1),\ldots\}$, with j=2,...,5. In other words, the past history of $s^1(t)$ incorporates all useful information in predicting its current value. If the hypothesis of noncointegration is rejected, it will be regarded as an evidence against the market efficiency hypothesis because of the prevalence of the error correction mechanism.

3. Empirical Results

Monthly data on the exchange rate of the A$ against the US dollar (US), the Japanese yen (J), the pound Sterling (UK), the German mark (G) and the French franc (F) are used for the period January 1975 to February 1990.[2]

With respect to the univariate time series properties of the data, the results

[2] The period 1975-1983 was mainly the era during which the Australian currency moved to a managed float from a pegged exchange rate to US dollar. The system of a market determined exchange rate was adopted in December 1983.

reported in Table 1 indicate that the null hypothesis of unit root is not rejected for the levels of all the series at a 5% significance level. In contrast, when first differences are used, nonstationarity is rejected in all cases.

Table 1
Phillips-Perron tests for stationarity

	Australian dollar bilateral exchange rates				
	US	J	UK	G	F
			pre-float		
Levels	-2.19	-1.92	-1.97	-1.41	-1.23
First Diff.	-12.02	-11.65	-10.42	-10.65	-12.31
			post-float		
Levels	-2.06	-0.64	-1.51	-1.43	-1.51
First Diff.	-8.80	-9.48	-7.40	-8.42	-8.25

Entries are the values of the $Z(t_\alpha)$ test statistic which is calculated with a lag length equal to 12. Other tests based on Phillips-Perron procedure confirm the existence of unit roots. These results can be obtained from the authors. The critical values are taken from Fuller, 1976 p.373.

Two VAR models with a constant term, and 6 lags (q=6) are then estimated. The selection of the lag structure is based on the residuals misspecification tests reported in Table 2. On inspection it is observed that serial correlation is rejected at a 5% significance level for all the equations.[3]

Table 2
Residual Mispecification Tests in the VAR Model (1)

Dep. V/ble	SEE	Q(24)	skewness	kurtosis	σ^2
		pre-float			
ΔUS	0.03	14.09(0.99)	-2.29(0.00)*	12.35(0.00)*	0.0005
ΔJ	0.03	38.56(0.14)	-0.45(0.07)	1.62(0.00)*	0.0006
ΔUK	0.03	17.38(0.97)	-1.34(0.00)*	8.59(0.00)*	0.0008
ΔG	0.03	26.48(0.65)	-0.53(0.03)*	1.49(0.00)*	0.0007
ΔF	0.03	23.05(0.81)	-0.54(0.03)*	3.82(0.00)*	0.0006
		post-float			
ΔUS	0.04	34.19(0.08)	0.21(0.49)	0.04(0.94)	0.0007
ΔJ	0.05	30.26(0.18)	-0.57(0.06)	0.62(0.32)	0.0012
ΔUK	0.04	24.02(0.46)	-0.49(0.11)	1.02(0.10)	0.0014
ΔG	0.05	31.11(0.15)	-0.54(0.07)	2.00(0.00)*	0.0013
ΔF	0.05	34.70(0.07)	-0.55(0.07)	1.84(0.00)*	0.0011

SEE refers to the standard error of the equation. Q(24) refers to Ljung-Box Q statistic for serial correlation at 24 degrees of freedom. σ^2 stands for the variance. Figures in parentheses are marginal significance levels (MSL). * Indicates significance at 5%.

[3] The skewness and kurtosis tests seem to suggest the presence of nonnormality in the pre-float regime.

In order to check for the presence of a linear trend in the nonstationary part of the data generation process, the hypothesis that a linear trend is absent ($\alpha'\mu=0$) is tested by means of the approach suggested by Johansen (1991). The trace test results given in Table 3 indicate that the absence of a linear trend cannot be rejected.

The results of testing for the number of cointegrating vectors between the five-A$ bilateral rates are also reported in Table 3. The LR test statistics that there are zero cointegrating vectors or five common trends reject the null hypothesis against the 95% critical value in both time periods. The trace test does not reject the hypothesis that at least two but possibly three or four cointegrating vectors are present in the pre-float regime. The maximum eigenvalue test does not reject the hypothesis $r\leq 2$ against $r\leq 3$. The trace test statistic for the post-float regime indicates the existence of four cointegrating vectors, implying that the change in the exchange rate regime has imposed two additional equilibrium constraints on the data. This suggests that future movements of one exchange rate can be predicted by using the information of other currencies. One implication of these findings is that the market efficiency hypothesis is rejected in a multivariate context. The other implication is that overall the system has moved to a greater stability in the post-float regime with four cointegrating vectors and one common trend.

Table 3
Johansen-Juselius Maximum Likelihood Cointegration Tests

r	n-r	T_r^*	95%	T_r	95%	$m\lambda^*$	95%	$m\lambda$	95%
				pre-float					
$r\leq 4$	1	6.31	9.094	1.03	8.083	6.31	9.094	1.03	8.083
$r\leq 3$	2	15.93	20.168	9.54	17.844	9.62	15.752	8.51	14.595
$r\leq 2$	3	28.97	35.068	21.43	31.256	13.04	21.894	11.89	21.595
$r\leq 1$	4	58.31	53.347	50.77	48.419	29.34	28.167	29.34	27.341
$r=0$	5	97.65	75.328	84.28	69.977	39.34	34.397	33.51	33.262
				post-float					
$r\leq 4$	1	4.94	9.094	4.94	8.083	4.94	9.094	4.94	8.083
$r\leq 3$	2	20.97	20.168	19.27	17.844	16.03	15.752	14.33	14.595
$r\leq 2$	3	41.45	35.068	39.75	31.256	20.48	21.894	20.48	21.595
$r\leq 1$	4	69.71	53.347	68.01	48.419	28.26	28.167	28.26	27.341
$r=0$	5	121.05	75.328	119.35	69.977	51.34	34.397	51.34	33.262

r and n-r denote the number of eigenvectors and common trends respectively. T_r^* (T_r) and $m\lambda^*$ ($m\lambda$) denote, respectively, the trace and maximum eigenvalue statistics for the restricted (unrestricted) model. Critical values are taken from Johansen and Juselius (1990a, Tables A2, A3).

Having established the existence of a long run exchange rate convergence, the analysis proceeds to investigate whether this convergence has been achieved in a symmetric way through adjustments by all exchange rates. In the VAR system (1), with x(t), α and β defined respectively as x=(US J UK G F), $\alpha=(\alpha_{US}\ \alpha_J\ \alpha_{UK}\ \alpha_G\ \alpha_F)$ and $\beta=(\beta_{US}\ \beta_J\ \beta_{UK}\ \beta_G\ \beta_F)$, it is desirable to test whether the cointegrating relationship $\beta'x(t-q)$ does not enter all the equations of the VAR system. In fact, the loading factor α_j (j=US,J,UK,G,F) entering the jth equation serves as a test of weak exogeneity of Δx_j with respect to the cointegraing parameters β [see Johansen and Juselius (1990b)].

The results of the likelihood ratio tests on loading factors reported in Table 4 indicate that the null hypothesis of zero loading is rejected for all currencies other than US dollar during the pre-float period. This means that all other currencies adjust to clear disequilibrium in foreign exchange markets. On the other hand, during the post-float regime, the hypothesis of zero loading is rejected for US dollar, mark and franc. In this period, adjustment in these currencies clear the disequilibrium. The analytical interpretation of these findings implies that exchange rate convergence has been achieved in an asymmetric manner.

Table 4
Testing for Zero Loading Factors

α-restriction	eigenvalues	$-2\ln Q(H_4^* \mid H_2^*)$
	pre-float	
$H_2^*:\Pi_q=\alpha\beta'$	(0.32 0.25 0.12 0.09 0.06)	-
$H_4^*:\alpha_{US}=0$	(0.31 0.25 0.12 0.07 0.00)	$\chi^2(2)=1.49$
$H_4^*:\alpha_J=0$	(0.28 0.16 0.09 0.09 0.00)	$\chi^2(2)=17.39^*$
$H_4^*:\alpha_{UK}=0$	(0.32 0.20 0.10 0.09 0.00)	$\chi^2(2)=6.58^*$
$H_4^*:\alpha_G=0$	(0.32 0.20 0.09 0.07 0.00)	$\chi^2(2)=6.58^*$
$H_4^*:\alpha_F=0$	(0.31 0.21 0.11 0.07 0.00)	$\chi^2(2)=6.79^*$
	post-float	
$H_2^*:\Pi_q=\alpha\beta'$	(0.53 0.34 0.26 0.21 0.07)	-
$H_4^*:\alpha_{US}=0$	(0.52 0.26 0.21 0.08 0.00)	$\chi^2(4)=24.02^*$
$H_4^*:\alpha_J=0$	(0.53 0.36 0.24 0.09 0.00)	$\chi^2(4)=9.35$
$H_4^*:\alpha_{UK}=0$	(0.54 0.32 0.24 0.17 0.00)	$\chi^2(4)=5.67$
$H_4^*:\alpha_G=0$	(0.42 0.35 0.24 0.08 0.00)	$\chi^2(4)=25.45^*$
$H_4^*:\alpha_F=0$	(0.38 0.31 0.24 0.07 0.00)	$\chi^2(4)=34.78^*$

* indicates significance at 5% .

4. Concluding remarks

The analysis of similarly integrated I(1) variables in a multivariate VAR framework rejected noncointegration between the A$ and other five leading currencies, and thus did not support the market efficiency hypothesis. One implication is that the efficiency hypothesis should be addressed in a multivariate context, when foreign currency movements are interdependent through international arbitrage. Furthermore, the nonexistence of a cointegrated relationship should not be interpreted as an evidence in favour of market efficiency.

REFERENCES

Dickey, D.A. and W.A. Fuller, 1981 Likelihood ratio statistics for autoregressive time series with a unit root, Econometrica 49,1057-1072.

Engle, R.F. and C.W.J Granger, 1987 Cointegration and error correction: representation, estimation and testing, Econometrica 55, 251-276.

Fama, E.F., 1970 Efficient capital markets: A review of theory and empirical work, Journal of Finance 25, 383-417.

Fuller, W.A., 1967 Introduction to Statistical Time Series, John Wiley and Sons, New York.

Fuller, W.A., 1985 Nonstationary autoregressive time series. In E.J.Hannan et al., (eds) Handbook of Statistics 5, Elsevier Sience Publishers B.V.

Johansen, S., 1991 Determination of cointegration rank in the presence of a linear trend, mimeo, University of Copenhagen, Institute of Mathematical Statistics.

Johansen, S., and K. Juselius, 1990a Maximum likelihood estimation and inference on cointegration-with applications to the demand for money, Oxford Bulletin of Economics and Statistics 52, 169-210.

Johansen, S., and K. Juselius, 1990b Some structural hypotheses in a multivariate cointegration analysis of the purchasing power parity and the uncovered interest parity for UK, Discussion Paper 90-05, Institute of Economics, University of Copenhagen.

MacDonald, R., and M. Taylor, 1989 Foreign exchange market efficiency and cointegration: Some evidence from the recent float, Economics Letters 29, 63-68.

Phillips, P.C.B., 1987 Time series regression with a unit root, Econometrica 55, 277-301.

Perron, P.P., 1988 Trends and random walks in macroeconomic time series: further evidence and implications, Journal of Economic Dynamics and Control 12, 279-332.

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28	P.Saunders	Australian Economic Papers, *19*(34),June 1980
29	W.P.Hogan, I.G.Sharpe & P.A.Volker	Economic Letters, 6 (1980), 7 (1981)
30	W.P.Hogan	Australian Economic Papers, *18*(33),December 1979
32	R.W.Bailey, V.B.Hall & P.C.B.Phillips	Keynesian Theory, Planning Models, and Quantitative Economics, G. Gandolfo and F. Marzano (eds.), *2*, 703-767, 1987
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50	P.Saunders	Economic Record, *57*(159), December 1981

53	J.Yates	AFSI, Commissioned Studies and Selected Papers, AGPS, IV 1982
54	J.Yates	Economic Record, *58*(161), June 1982
55	G.Mills	Seventh Australian Transport Research Forum-Papers, Hobart, 1982
56	V.B.Hall & P.Saunders	Economic Record. *60*(168), March 1984
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61	S.S.Joson	Australian Economic Papers, *24*(44),June 1985
62	R.T.Ross	Australian Quarterly, *56*(3), Spring 1984
63	W.J.Merrilees	Economic Record, *59*(166), September 1983
65	A.J.Phipps	Australian Economic Papers,*22*(41),December 1983
67	V.B.Hall	Economics Letters, 12, 1983
69	V.B.Hall	Energy Economics, *8*(2), April 1986
70	F.Gill	Australian Quarterly, *59*(2), Winter 1987
71	W.J.Merrilees	Australian Economic Papers,*23*(43),December 1984
73	C.G.F.Simkin	Singapore Economic Review,*29*(1),April 1984
74	J.Yates	Australian Quarterly, *56*(2), Winter 1984
77	V.B.Hall	Economics Letters, 20, 1986
78	S.S.Joson	Journal of Policy Modeling, *8*(2), Summer 1986
79	R.T.Ross	Economic Record, *62*(178), September 1986
81	R.T.Ross	Australian Bulletin of Labour, *11*(4), Sept.1985
82	P.D.Groenewegen	History of Political Economy, *20*(4),Winter 1988 Scottish Journal of Political Economy,*37*(1)1990
84	E.M.A.Gross, W.P.Hogan & I.G.Sharpe	Australian Economic Papers, *27*(50), June 1988
85	F.Gill	Australian Bulletin of Labour, *16*(4),Dec.1990
94	W.P.Hogan	Company and Securities Law Journal, *6*(1), February 1988
95	J.Yates	Urban Studies, *26*, 419-433, 1989
96	B.W.Ross	The Economic and Social Review, *20*(3),April 1989
97	F.Gill	Australia's Greatest Asset: Human Resources in the Nineteenth and Twentieth Centuries, D.Pope(ed.), Federation Press, 1988
99	R.T.Ross	Australian Bulletin of Labour, *15*(1), December 1988
100	L.Haddad	Hetsa Bulletin, (11), Winter 1989
101	J.Piggott	Public Sector Economics - A Reader, P.Hare(ed.), Basil Blackwell, 1988
104	P.D.Groenewegen	Decentralization, Local Government and Markets: Towards a Post-Welfare Agenda, R.J. Bennet (ed.) Oxford University Press, *6*, 87-115, 1990
107	B.W.Ross	Prometheus, *6*(2), December 1988
108	S.S.Joson	Rivista Di Diritto Valutario e Di Economia Internazionale, *35*(2), June 1988

112	P.Groenewegen	NeoClassical Economic Theory 1870 to 1930 K.Hennings & W.Samuels (eds.), 13-51, 1990
113	V.B.Hall, T.P.Truong & V.A.Nguyen	Energy Economics, *12*(4) October 1990
114	V.B.Hall, T.P.Truong & V.A.Nguyen	Australian Economic Review, (87) 3'89
115	F.Gill	Australian Journal of Social Issues, *25*(2), May 1990
116	G.Kingston	Economics Letters, 15 (1989)
117	V.B.Hall & D.R.Mills	Pacific and Asian Journal of Energy, *2*(2), December 1988
118	W.P.Hogan	Abacus, *25*(2), September 1989.
120	P.Groenewegen	Flattening the Tax Rate Scale: Alternative Scenarios & Methodologies, (eds.) J.G. Head and R. Krever, *1*, 3-31, 1990
122	W.P.Hogan & I.G. Sharpe	Economic Analysis and Policy, *19*(1), March 1989
123	G.Mills	Journal of Transport Economics and Policy, *23*, May 1989
126	F.Gill	The Australian Quarterly, *61*(4), 1989
128	S.Lahiri & J.Sheen	The Economic Journal, *100*(400), 1990
143	C.J.Karfakis	Applied Economics, *23*, 1991
144	C.J.Karfakis & D.Moschos	Journal of Money, Credit, and Banking, *22*,(3),1990
158	W.P.Hogan	Economic Papers, *10*,(1), March 1991