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Black and official exchange rates in the Pacific Basin: some tests of dynamic behaviour

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Black and official foreign exchange rates have co-existed for many years in a number of major Pacific Basin countries. In this paper, a framework is developed for examining the relationship between the two types of exchange rates in the cointegration and error correction context for both the short and long run. This is applied to the data over the period January 1974 to June 1992. Evidence against the standard portfolio theory of black market behaviour is found.

I. INTRODUCTION

Black markets for foreign exchange exist in all developing countries, except the high income oil exporters. These are the result of limited access to the official markets for foreign exchange and the existence of foreign exchange restrictions on international transactions. The evidence available suggests that black markets have recently increased in size and sophistication in many countries, in relation with capital movement.[1] In this paper, we examine the efficiency of black and official exchange markets in the Pacific Basin region. In particular, we examine whether agents use information from the official exchange market to predict the future path of black market exchange rates.

Few studies have examined the dynamic relationship between black and official exchange rates. Gupta (1981) examined Korea, Taiwan and India. On the basis of cross-correlations between changes in the black market rate and changes in the official exchange rate, he found that black market rates in Taiwan and Korea (not in the case of India), anticipate changes in the official rate. He took that as an indication of market efficiency. Akgiray *et al.* (1989), applied Granger-type causality tests between black and official exchange rates for the case of Turkey. They found the adjustment process to be relatively rapid and not to be observed in weekly or monthly data. They concluded that the Turkish foreign exchange black markets process information efficiently.

More recently, Booth and Mustafa (1991) also looked at the foreign exchange markets in Turkey. They took into account the fact that the exchange rate series might not be stationary, in which case OLS regression results might be spurious, and applied the co-integration technique to explore the long-run dynamics of the two markets, using the two stage method described by Dickey and Fuller (1979). They pointed out that the presence of co-integration is inconsistent with the notion that asset markets are informationally efficient by invoking the link between the concept of co-integration and error correction mechanism established by the Granger Representation theorem (see Engle and Granger, 1987). The existence of an error correction model implies feedback (possibly contemporaneous) from one market to the other and violates the efficient market hypothesis, which says that no other information other than the past behaviour of the exchange rate in question should be used in predicting the future rate. Booth and Mustafa (1991) found that the black markets for the Turkish Lira versus the US dollar and the German mark are informationally efficient and behave independently of each other. When they compared black and official rates, they arrived at the opposite conclusion. In a similar way Phylaktis and Kassimatis (1994a)

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[1] See World Currency Year Book (1990).

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examined the long-run relationship between the black and official exchange rate within the cointegration and error correction models for a group of Pacific Basin countries. In their analysis, however, the likelihood ratio test due to Johansen (1988) and Johansen and Juselius (1990) was used, which is a more powerful method relative to other cointegration tests applied in previous studies.[2]

This paper contributes to the literature in the following way. It shows that cointegration of black and official market rates does not necessarily imply market informational inefficiency. It distinguishes between short-run predictability and long-run efficiency and in doing so it puts in context, on the one hand, Akgiray *et al.*'s (1989) notion of informational efficiency, i.e. rapid adjustment process to equilibrium following a shock, and on the other hand, Booth and Mustafa's (1991) and Phylaktis and Kassimatis's (1994a) concept of efficiency of agents using information from the official exchange market to predict the future path of the black market exchange rate. We develop a formal procedure for testing the relationship between black and official exchange rates based on Johansen (1992) and Moore (1994). We derive the necessary and sufficient conditions for short-run predictability and long-run informational efficiency within the co-integration and error correction context. We subsequently apply the procedure to the black and official exchange markets in a group of Pacific Basin countries, Malaysia, Singapore, Korea, Taiwan, Thailand, Indonesia and the Philippines for the period January 1974 to June 1992.

The theory of black market exchange rates provides us with an insight into the joint dynamics of black and official exchange rates. For example, the portfolio balance model[3], where conditions in the asset markets determine the black market rate at any point in time, while the current account affects the black market rate through its impact on the stock of black dollars, imply the existence of an equilibrium spread between the black market and official rates, or otherwise called the black market premium. Furthermore, the models imply that the black market rate depreciates in the same proportion as the official rate in the long-run giving a constant or stationary black market premium.[4]

This also has relevance for the ability to forecast the black market rate in the short-term or to predict the black market premium from its past history. First, portfolio models of black foreign exchange markets assume that the official rate is exogenous: this has implications which are testable. Portfolio theories also suggest that the short-run dynamics of the black market premium are governed by saddle path behaviour. This has the second implication that the impact effect of a change in the official rate is less than one-for-one on the black market rate i.e. that the black market premium declines following an unanticipated devaluation (Phylaktis, 1997). This is dictated by the presumption that the stock of black market foreign currency is fixed in the short-run. An additional implication is that after an initial shock, the black market premium adjusts to equilibrium in a predictable manner: in particular, the black premium should be autocorrelated. This predictability is not a violation of efficiency but the outcome of optimal arbitrage behaviour along a saddle-path.

The paper is structured as follows. Section II describes the characteristics of foreign exchange markets in the Pacific Basin countries. Section III derives the necessary and sufficient conditions to test for long-run efficiency and short-run predictability in a co-integration context. In Section IV, the methodology is applied to seven Pacific Basin countries. The final section presents a summary of the empirical findings and considers their economic interpretation.

II. FOREIGN EXCHANGE MARKETS IN THE PACIFIC BASIN REGION

Black markets activities in the seven Pacific Basin countries of our sample have existed for several years.[5,6] In the Philippines, Singapore and Malaysia, for example, the black market goes back to the 1940s. These markets have persisted not only because of the variety of foreign exchange controls in use and the manipulation of the exchange rate by the monetary authorities, but also because of reasons related to social and political unrest, and economic malaise.

Nevertheless, the seven countries that we consider clearly fall into two institutional categories. The first group consists of five countries: Malaysia, Singapore, Taiwan, Korea

[2] See Kremers *et al.* (1992).

[3] The portfolio balance model was initially developed by Dornbusch *et al.* (1983) and later extended by Phylaktis (1991) to incorporate explicitly the effects of foreign exchange rate restrictions.

[4] In order to explain this let us assume that there is a once and for all official devaluation, which is anticipated. Economic agents recognizing the potential gains in the value of the dollar increase the demand for black dollars and cause the black market premium to rise, given a fixed available stock of black dollars in the short-run. The higher premium will create, however, a current account surplus and subsequently an increase in the stock of black dollars. When the devaluation actually occurs, the premium declines. There is no movement at all in the black rate since all the changes were anticipated in the initial jump of the black rate. The transitory accumulation of black dollars, induced by the initial jump in the level of the premium preceding the actual devaluation, will be eliminated through the reverse effect of the decline in the premium on the current account. In the long-run, the premium remains unchanged.

[5] See World Currency Yearbook, several issues.

[6] See Kiguel and O'Connell (1995) for a more general discussion on the emergence of black markets.

and Thailand. They are characterized by having greater or lesser degrees of adherence to a framework of law. This is not to idealize them: if they were well-ordered societies, they would not have black market activity at all. Black markets in Taiwan and Korea were sustained by strict foreign exchange controls. It was only in the late 1980s that both countries embarked on a liberalization scheme (Taiwan in 1987 and Korea in 1988). In addition, in Korea black market activities were supported by the funding of capital flight. In Thailand on the other hand, the development of black market for dollars was associated with narcotics related activities.[7] Even in countries like Singapore and Malaysia where foreign exchange controls were abolished (in 1978 and 1979 respectively), there was a black market although of a limited nature. In the case of Malaysia, capital flight from Indonesia supported the market while the black economy which existed for tax evasion purposes fostered demand for black dollars. In the case of Singapore, the demand for black dollars was by Muslim Indians who collected foreign currency to send by courier to India. However, in this first group of countries, conventional economic activities were not dominated by crime and corruption.

The other group of countries consists of Indonesia and the Philippines. In Indonesia, where there were no controls on capital flows, the black market for dollars was sustained by a host of protectionist import measures, which created incentives to smuggle goods and demand black market dollars and by an exchange tax on export proceeds which diverted foreign currency to the black market; furthermore, by a huge amount of money from corruption (which was estimated to account about 30% of GDP), and by capital flight to secure the wealth of the political class. In the Philippines black markets were further supported by outright theft of dozens of millions of US dollars of foreign support and assistance payments, and by the funding of capital flight which took place because of fear of dictatorship, of confiscation of assets and of blocking of bank accounts.

During the period of examination there has been official intervention in the foreign exchange market, the degree of which varied across the countries and over the period. With the exception of Singapore and Malaysia, which placed the effective rate of their currencies on a controlled floating basis in the early 1970s, the rest of the Pacific Basin countries continued to link their currencies to the US dollar following its floating in 1971, and to control their exchange rates by reducing the gold content of their currencies. This regime came to an end when each country in turn broke the link with the US dollar and established a controlled floating effective rate (Indonesia and Thailand in 1978, Taiwan in 1979, Korea in 1980 and Philippines in 1984).[8]

III. CO-INTEGRATION AND EFFICIENT BLACK MARKETS

It is clear that, for the black market in foreign exchange to be informationally efficient, the black market and official exchange rates must be co-integrated. Otherwise, they would drift arbitrarily far apart enabling position takers to make arbitrage profits without any obvious upper bound.

$$b_t = \beta_0 + \beta_1 e_t + u_t \tag{1}$$

where b_t and e_t are logarithms of the black market and official exchange rates respectively, β_0 and β_1 are parameters and u_t is a stationary error term. However, this immediately creates an apparent contradiction. From the Granger Representation Theorem, we know that if two nonstationary variables are co-integrated, then their vector autoregressive representation can be expressed as an error correction mechanism (ECM). This can be represented as follows:[9]

$$\Delta b_t = \rho_1(b_{t-1} - \beta_1 e_{t-1} - \beta_0) + \sum_{i=1}^{n-1} \gamma_i \Delta b_{t-i} + \sum_{i=1}^{n-1} \delta_i \Delta e_{t-i} + u_{bt} \tag{2}$$

$$\Delta e_t = \rho_2(b_{t-1} - \beta_1 e_{t-1} - \beta_0) + \sum_{i=1}^{n-1} \zeta_i \Delta b_{t-i} + \sum_{i=1}^{n-1} \eta_i \Delta e_{t-i} + u_{et} \tag{3}$$

where ρ_1, ρ_2, γ_i, δ_i, ζ_i and η_i, $i = 1$ to $n-1$ are parameters and u_{bt} and u_{et} are error processes. At the very least, one of the equations must contain the ECM term: in other words, either ρ_1 or ρ_2 must be statistically significant. This seems to imply that time $t-1$ information can be used to systematically forecast the black market exchange rate. Moore (1994) has posed a similar puzzle in connection with the forward foreign exchange market.[10] In general, the resolution lies in specifying a set of restrictions on the parameters in Equations 2 and 3 which are compatible with both informational efficiency and co-integration. Dwyer and Wallace

[7] Thailand was an important shipping smuggling centre for drugs during the 1970s and 1980s.
[8] See International Monetary Fund, *Exchange Arrangements and Exchange Restrictions* (several issues).
[9] Equations (2) and (3) illustrate the case of a restricted constant. This rules out deterministic linear trends in the individual series. Of course, this restriction needs to be tested.
[10] The issue was originally raised in connection with the forward market by Hakkio and Rush (1989) but their approach was flawed.

(1992) have already derived conditions for informational efficiency in terms of the Cramer–Wold moving average representation. The focus in this paper is on the VAR representation because it makes the implications for estimation and testing clearer.

Define long-run informational efficiency as the notion that the black market premium is stationary:

Proposition 1 (Long-run informational efficiency) For long-run informational efficiency in the black market, we require that (i) the black and official rates are co-integrated, and (ii) the parameter $\beta_1 = 1$.

If we impose condition (ii) of Proposition 1 on the black market Equation 2, we obtain

$$b_t = \text{constant} + e_t - \Delta e_t + (1+\rho_1)(b_{t-1} - e_{t-1}) + \sum_{i=1}^{n-1}\gamma_i \Delta b_{t-i} + \sum_{i=1}^{n-1}\delta_i \Delta e_{t-i} + u_{bt} \quad (4)$$

Substituting for Δe_t in Equation 4 from Equation 3 yields:

$$b_t = \text{constant} + e_t + (1+\rho_1-\rho_2)(b_{t-1} - e_{t-1}) + \sum_{i=1}^{n-1}(\gamma_i - \zeta_i)\Delta b_{t-i} + \sum_{i=1}^{n-1}(\delta_i - \eta_i)\Delta e_{t-i} + u_{bt} - u_{et} \quad (5)$$

This immediately suggests a stronger concept than informational efficiency, namely that the black market premium cannot be predicted from its past history. In other words, that the black market premium is nonautocorrelated i.e. $b_t = e_t + \text{noise}$. An examination of Equation 5 shows that if this is to hold for all values of the error correction term and Δb_{t-i}, Δe_{t-i}, $i = 1, \ldots, n-1$ the following holds:

Proposition 2 (Short-run unpredictability) For short-run unpredictability in the black market, we require (i) the conditions for long-run informational efficiency in Proposition 1; (ii) that the ECM adjustment parameters in the two equations differ by minus unity, $\rho_1 - \rho_2 = -1$; (iii) that the parameters governing lags of changes in the black rate be the same in each equation i.e. $\gamma_i = \zeta_i \quad \forall i$; and (iv) that the parameters governing lags of changes in the official rate be the same in each equation i.e. $\delta_i = \eta_i \quad \forall i$.

The surprising aspect of the conditions in proposition 2 is that we place no *a priori* restrictions on the lag length of the VAR in Equations 2 and 3.

Johansen (1992) shows that a useful special case occurs when one of the variables is weakly exogenous. This is equivalent to only one equation containing an error correction term i.e. either ρ_1 or ρ_2 is zero. A natural candidate for weak exogeneity is the official rate. In this case, the error correction representation of the black rate can be efficiently estimated as a single equation structural model conditioning on the marginal distribution of the change in the official rate.

$$\Delta b_t = \tilde{\delta}_0 \Delta e_t + \rho_1(b_{t-1} - \beta_1 e_{t-1} - \beta_0) + \sum_{i=1}^{n-1}\tilde{\gamma}_i \Delta b_{t-1} + \sum_{i=1}^{n-1}\tilde{\delta}_i \Delta e_{t-i} \quad (6)$$

where $\tilde{\delta}_0$, $\tilde{\delta}_i$ and $\tilde{\gamma}_i$, $i = 1, \ldots, (n-1)$ are parameters.

Letting $\begin{bmatrix} \sigma_{bb} & \sigma_{be} \\ \sigma_{be} & \sigma_{ee} \end{bmatrix}$ be the variance covariance matrix of (u_{bt}, u_{et}), the parameters of Equation 6 are related to the original VAR in Equations 2 and 3 as follows:

$$\begin{aligned} \tilde{\delta}_0 &= \sigma_{be}\sigma_{ee}^{-1} \\ \tilde{\delta}_i &= \delta_i - \sigma_{be}\sigma_{ee}^{-1}\eta_i \\ \tilde{\gamma}_i &= \gamma_i - \sigma_{be}\sigma_{ee}^{-1}\zeta_i \\ \tilde{u}_t &= u_{bt} - \sigma_{be}\sigma_{ee}^{-1}u_{et} \end{aligned} \quad (7)$$

It is not immediately obvious that proposition 2 still provides us with the conditions for short-run unpredictability. To clarify this, impose long-run informational efficiency and rewrite Equation 6 as follows:

$$b_t = \text{constant} + e_t - \Delta e_t + (1+\rho_1)(b_{t-1} - e_{t-1}) + \tilde{\delta}_0 \Delta e_t + \sum_{i=1}^{n-1}\tilde{\gamma}_i \Delta b_{t-i} + \sum_{i=1}^{n-1}\tilde{\delta}_i \Delta e_{t-i} + \tilde{u}_t \quad (8)$$

Using Equation 7, this can be transformed to:

$$b_t = \text{constant} + e_t + (1+\rho_1)(b_{t-1} - e_{t-1}) - (1-\tilde{\delta}_0)(\Delta e_t) + \sum_{i=1}^{n-1}(\gamma_i - \tilde{\delta}_0\zeta_i)\Delta b_{t-i} + \sum_{i=1}^{n-1}(\delta_i - \tilde{\delta}_0\eta_i)\Delta e_{t-i} + (u_{bt} - \tilde{\delta}_0 u_{et}) \quad (9)$$

Rearranging:

$$b_t = \text{constant} + e_t - \Delta e_t + (1+\rho_1)(b_{t-1} - e_{t-1}) + \sum_{i=1}^{n-1}\gamma_i \Delta b_{t-i} + \sum_{i=1}^{n-1}\delta_i \Delta e_{t-i} + u_{bt} + \tilde{\delta}_0\left[\Delta e_t - \sum_{i=1}^{n-1}\eta_i \Delta e_{t-i} - \sum_{i=1}^{n-1}\zeta_i \Delta b_{t-i} - u_{et}\right] \quad (10)$$

The expression in the hard brackets is zero. To see this, note that it is a rearranged version of Equation 3 when $\rho_2 = 0$. Consequently, Equation 10 degenerates into Equation 4 from which proposition 2 was stated. Unfortunately, proposition 2 is not very helpful under weak exogeneity because the parameters δ_i, η_i, γ_i and ζ_i cannot be identified from single equation estimation. Nevertheless there are conditions on Equation 6 which are sufficient but not necessary. These are summarized in proposition 3:

Proposition 3 For short-run unpredictability when the official rate is weakly exogenous, sufficient conditions are: (i) the conditions for long-run informational efficiency in Proposition 1; (ii) that the ECM adjustment parameter in the black rate equation $\rho_1 = -1$; (iii) that the coefficient on Δe_t is unity i.e. $\tilde{\delta}_0 = 1$; and (iv) that the lag length of the VAR is unity i.e. $\tilde{\delta}_i = \tilde{\gamma}_i = 0 \quad \forall i$.

In the next section, it will emerge empirically that the black rate can also be weakly exogenous. The estimated equation takes the form

$$\Delta e_t = \tilde{\zeta}_0 \Delta b_t + \rho_2 (b_{t-1} - \beta_1 e_{t-1} - \beta_0) + \sum_{i=1}^{n-1} \tilde{\zeta}_i \Delta b_{t-1} + \sum_{i=1}^{n-1} \tilde{\eta}_i \Delta e_{t-i} + \text{noise} \qquad (11)$$

where $\tilde{\zeta}_0$, $\tilde{\zeta}_i$ and $\tilde{\eta}_i$, $i = 1, \ldots, (n-1)$ are parameters which are defined by analogy to those in Equation 7. By analogy with proposition 3, sufficient conditions for unpredictability in this case are given by the following:

Proposition 4 For short-run unpredictability, when the black rate is weakly exogenous, sufficient conditions are: (i) the conditions for long-run informational efficiency in Proposition 1; (ii) that the ECM adjustment parameter in the black rate equation $\rho_2 = 1$; (iii) that the coefficient on Δb_t is unity i.e. $\tilde{\zeta}_0 = 1$; and (iv) that the lag length of the VAR is unity i.e. $\tilde{\zeta}_i = \tilde{\eta}_i = 0 \quad \forall i$.

IV. EMPIRICAL RESULTS

Preliminaries

We analyse the relationship between the black and official US dollar exchange rates for seven Pacific Basin currencies. The countries studied were Indonesia, Korea, Malaysia, the Philippines, Thailand, Taiwan and Singapore using monthly data over the period 1974(1) to 1992(6).[11] In Table 1, we present some stylized facts on the black and official exchange rates for those countries. In all the cases there is no statistically significant difference between the means of the black and official rates. It is interesting to observe that for three of the seven countries, the black market rate is below the official rate on average. This reflects factors such as tax evasion and money laundering related to drug trafficking. In contrast the black market

Table 1. *Summary statistics of exchange rates*

	Mean	Variance	Maximum	Minimum	SE	*F*
Indonesia						
e_0	0.710	0.178	40.947	−0.546	0.08	1.57
e_b	0.766	0.279	48.624	−11.252		
Korea						
e_0	0.303	0.035	19.312	−2.697	0.089	4.36
e_b	0.318	0.155	17.038	−10.064		
Malaysia						
e_0	0.005	0.021	7.889	−7.859	0.019	2.49
e_b	0.014	0.054	9.173	−1.121		
Philippines						
e_0	0.588	0.088	25.128	−7.130	0.100	3.25
e_b	0.584	0.288	47.000	−18.232		
Singapore						
e_0	−0.199	0.022	7.698	−6.143	0.016	2.45
e_b	−0.207	0.054	12.802	−11.506		
Thailand						
e_0	0.092	0.020	16.293	−4.061	0.036	6.25
e_b	0.109	0.129	14.651	−11.960		
Taiwan						
e_0	−0.205	0.011	4.246	−6.844	0.063	10.24
e_b	−0.254	0.115	7.994	−11.277		

Notes: e_0 and e_b are the logarithms of the official and black market rate respectively multiplied by 10^{-2}. SE is the standard error of the difference between the two means. *F* is the test statistic of the ratio of the two exchange rates variances. The critical values of *F*(227, 227) are 1.24 (5%) and 1.37 (1%). In Taiwan where the sample is smaller the critical values of *F*(185.85) are 1.27 (5%) and 1.41 (1%).

[11] The data set for Taiwan only extends to 1989(9).

rate is more volatile than the official rate as it is free to respond to actual and anticipated changes in economic conditions. This is confirmed by the F-test on the ratio of the two variances which in all cases is higher than the critical value.

In accordance with usual practice, the 14 data series were initially tested for stationarity. The Johansen unit root test was applied and the null of stationarity was rejected in every case. Next, a bivariate VAR was created for black and official exchange rate pair and tested for lag length using the Box–Pierce Q test in each equation. The shortest lag length $(n = 1)$ was selected for four countries – Indonesia, Korea, Thailand and Taiwan. Malaysia and Singapore have $n = 2$ and the Philippines had the most parameterized VAR at $n = 3$. The Johansen trace tests revealed that there is at least one cointegrating vector for each country.[12]

In the general error-correction representation in Equations 2 and 3, the constant β_0 was restricted to be inside the co-integrating relationship. This notation assumes that there is no constant term in the ECM outside the co-integrating vector and needs to be tested for at this stage. Johansen (1991) shows that the restriction can be tested by examining the difference between the values of the Johansen trace statistic in each case. The resulting test statistic is distributed χ^2 with $(p - r)$ degrees of freedom, under the null of a restricted constant, where p is the number of variables and r is the number of co-integrating vectors. The results are shown in Table 2. In four of the seven countries – Korea, Malaysia, Singapore and Thailand – the restriction is not rejected.

The reported results are structured as follows: first, we show the results of tests for long-run informational efficiency; secondly, we test for the exogeneity of the official exchange rate; finally, we test for two predictions of portfolio models. These are that the impact effect of an unanticipated official devaluation reduces the black premium by less than one-for-one and that the black market premium is autocorrelated.

Table 2. *Tests for restriction of constant*

Country	Test statistic $\chi^2(1)$
Indonesia	7.16*
Korea	6.38
Malaysia	0.02
Philippines	8.75*
Singapore	4.88
Thailand	1.02
Taiwan	7.38*

Notes: * indicates rejection of restriction at 1%

Table 3. *Tests of long-run efficiency restricted constants*

Country	Test statistic $\chi^2(1)$
Korea	2.22
Malaysia	0.92
Singapore	9.62*
Thailand	0.21

Notes: * indicates rejection at 1%.

Table 4. *Tests of long-run efficiency unrestricted constants*

Country	Test statistic $\chi^2(1)$
Indonesia	5.11
Philippines	0.51
Taiwan	4.47

Notes: * indicates rejection of restriction at 1%

Long-run efficiency

Proposition 1 requires that the slope be unity in the cointegrating vector. Table 3 presents the test that $\beta_1 = 1$ for the four countries with restricted constants – Korea, Malaysia, Singapore and Thailand, while Table 4 presents the test for the countries with unrestricted constants, Indonesia, Philippines and Taiwan. It is clear that long-run informational efficiency is not rejected in all but one case, Singapore. The precise cointegrating relationship for Singapore is $b = 0.95e + 0.042$ and the constant is statistically significant as well as the slope. The slope and constant are also jointly significant.

Exogeneity

Tests for $\rho_1 = 0$ and $\rho_2 = 0$ were carried out: these constitute tests for weak exogeneity which is necessary for strong exogeneity. This involved the likelihood ratio test:

$$-2 \ln Q = T \sum_{i=1}^{r} \ln \frac{1 - \tilde{\lambda}_i}{1 - \lambda_i} \qquad (12)$$

where the $\tilde{\lambda}_i$ are the squared canonical correlations under the restriction and the λ are the unrestricted variety. Under the null of weak exogeneity, the test statistic in Equation 12 is distributed χ^2 with $r(p - m)$ degrees of freedom where m is the number of restrictions. In the present case it is χ^2 (1) and the results are shown in Table 5.

With the exception of Taiwan, the results are unambiguous: one of the variables is weakly exogenous in every case. The official rate plays this role in four countries – Korea, Malaysia, Singapore and Thailand – while the

[12] The results of the unit root rests, lag length selection and cointegration tests were obtained conventionally and are available from the authors on request.

Table 5. *Tests of weak exogeneity: $\chi^2(1)$*

Country	Official rate $\rho_1 = 0$	Black rate $\rho_2 = 0$
Indonesia	13.08	0.89*
Korea	1.34*	10.56
Malaysia	0.95*	21.65
Philippines	12.70	1.14*
Singapore	0.37*	23.52
Thailand	0.99*	37.37
Taiwan	10.86	10.96

Notes: * indicates that the null of weak exogeneity is not rejected.

black rate is weakly exogenous in Indonesia and the Philippines.

Impact effect of unanticipated devaluation

For the four countries, where the official rate is weakly exogenous, the portfolio model also predicts that the impact effect of a surprise devaluation on the market rate should be less than one-for-one i.e. $\tilde{\delta}_0 < 1$.[13] The first column in Table 6 provides us with the point estimates of $\tilde{\delta}_0$ along with their standard errors. It is clear that the estimates for both Malaysia and Singapore are economically close to the null of unity. In fact, in all four countries the estimates are not significantly different from unit at the 1% significance level.

Short-run unpredictability

It is easy to test directly for short-run unpredictability: it is simply a matter of testing the black market premium for autocorrelation: such test results confirm what follows and are available upon request. However, it is more revealing to set the tests within the context of Section III. Testing for short-run unpredictability depends on the results of the weak exogeneity tests of Table 5. Only Proposition 2 can be applied to the case of Taiwan because neither the official nor the black rate are weakly exogenous. Proposition 3 is relevant to Korea and Malaysia, Singapore and Thailand because the official rate is weakly exogenous. Finally, Indonesia and the Philippines equations are tested against Proposition 4 which arises when the black rate is weakly exogenous.

Proposition 2

This proposition is relevant to Taiwan where neither rate is weakly exogenous. In addition to the conditions for long-run efficiency, this requires that the two ECM adjustment coefficients should differ by minus unity. In general, there are also other restrictions on the short-run dynamics but these do not arise in the Taiwanese case because the lag length is 1.

It is clear from Table 7 that the condition for short-run predictability is decisively rejected. The difference between the two ECM parameters is -0.2679 which is both economically and statistically far from minus unity.

Proposition 3

Table 6 summarizes the results of testing for the requirements of proposition 3 in the cases of the four countries for which the official rate is weakly exogenous. We reported the tests on $\tilde{\delta}_0$ above which are contained in the first column of Table 6. In this case, the results can be interpreted as support for short-run unpredictability. In contrast, column 2 provides evidence against short-run unpredictability as all four countries have ECM adjustment coefficients which are both economically and statistically far from minus unity. Column 3 is only relevant when the ECM contains short-run dynamics: this arises in the case of Singapore and, not surprisingly, the zero restrictions are rejected. The final column tests all the restrictions of Proposition 3 jointly. For every country, they are rejected.

Proposition 4

The results in Table 8 indicate that for the two countries where the black rate is weakly exogenous, the rejection of

Table 6. *Short-run predictability: official rate weakly exogenous*

	$\tilde{\delta}_0$ (*standard error*)	ρ_1 (*standard error*)	F test $\tilde{\delta}_i = \tilde{\gamma}_i = 0$	All tests jointly
Korea	0.699	−0.085*	not applicable	$F(2,222) = 535.9$*
	(0.129)	(0.028)		
Malaysia	0.925	−0.519*	not applicable	$F(2,222) = 34.4$*
	(0.074)	(0.059)		
Singapore	0.932	−0.574*	$F(2,219) = 13.73$*	$F(4,219) = 8.55$*
	(0.058)	(0.083)		
Thailand	0.878	−0.417*	not applicable	$F(2,222) = 56.36*$
	(0.141)	(0.055)		

Notes: indicates rejection of restriction at 1%.

[13] In general, this coefficient does not measure the impact effect of a *surprise* devaluation. In the cases of Korea and Thailand, where the lag length of the VAR is 1, there is however no ambiguity. In the cases of Malaysia and Singapore, the VAR lag length is 2 so that the coefficient measures the contemporaneous effect of both surprise and anticipated components of a devaluation. However, this merely accentuates the point. Footnote 4 shows that the contemporaneous effect of an anticipated devaluation on the black rate should be zero.

Table 7. *Short-run predictability: Taiwan*

ρ_1 (Black rate equation)	ρ_2 (Official rate equation)	$\rho_1 - \rho_2 = 1$ $\chi^2(1)$
−0.196 (0.055)	0.071 (0.018)	195.9

short-run predictability is comprehensive. The coefficients in both of the first two columns are meant to be unity under Proposition 4: they clearly are not, in any sense. The tests in the final two columns have the same interpretation as in Table 6 and the outcome is just as clearcut.

V. DISCUSSION

This paper develops the necessary and sufficient conditions for informational efficiency within the co-integration and error correction framework. The procedure is applied to a group of Pacific Basin countries for the period January 1974 to June 1993. The results can be summarized as follows.

The seven countries we have examined fall into two categories. There is a pattern of results within each category albeit with a number of exceptions. The first group consists of four countries: Korea, Malaysia, Singapore and Thailand. For each of these countries, the official rate is weakly exogenous. Second, the impact effect of a change in the official rate on the black market rate is one (i.e. $\delta_0 \approx 1$). Third, there is no drift in the short-run dynamics (i.e. the constant is restricted). Fourth, the coefficient of the error correction term is negative, that is if the black market premium is above its equilibrium level, the black market rate will decline as implied by the portfolio models. In these models the black market rate changes following a monetary shock to restore equilibrium in the stock market for black currency. This impact effect on the black market rate is greater than the long-run effect because the stock of black dollars is fixed in the short-run. As time goes by, however, and the change in the black market rate feeds into the current account, the stock of black dollars changes, and the black market rate moves towards its long-run value reversing part of the initial change.

Fifth, the speed of adjustment following a shock is slow. The rate of adjustment is approximately 50% per period (i.e. $\rho_1 \approx -1/2$) for three of the countries (Malaysia, Singapore and Thailand), and 8% for Korea. This compares with 21 and 34 days for a new equilibrium to be restored in the aftermath of a shock in the case of the Turkish Lira versus the Deutsch Mark and the Dollar respectively (see Booth and Mustafa, 1991).

Finally, for three of these countries, Korea, Malaysia and Thailand, not only does long-run efficiency hold but the steady black market premium is zero. The exception is Singapore where we have the startling result that the long-run relationship is described by $b = 0.042 + 0.95e$. This violates informational efficiency and implies a long-run premium as well. The black market rate depreciates less than the official rate and agents could keep a dollar position in the knowledge that they will make profits when they convert their dollars back into domestic currency. Such a situation could arise when there is official intervention in the foreign exchange market to influence the exchange rate. Singapore since 1975 pegged the Singapore Dollar to an undisclosed basket of currencies in the early 1970s with emphasis on maintaining a strong currency to contain inflation and instill confidence in its financial markets (see Moreno, 1988).[14]

The other group of countries consists of Philippines, Indonesia and possibly Taiwan. For all three countries long-run efficiency holds. On the other hand, short-run unpredictability is rejected. Indeed for the first two countries, the black market rate is weakly exogenous. Second, the impact effect of a change in the black rate is not one-for-one on the official rate: $\zeta_0 \approx 1/2$ for Indonesia and $\zeta_0 \approx 1/3$ for the Philippines. Third, there is a drift in the short-run dynamics (i.e. the constant is restricted); this immediately rules out the existence of a significant long-run risk premium.

Finally, adjustment to long-run disequilibrium takes place at a rate of approximately one-tenth per period for

Table 8. *Short-run predictability: black rate weakly exogenous*

	$\tilde{\zeta}_0$ (*standard error*)	ρ_2 (*standard error*)	F Test $\tilde{\zeta}_i = \tilde{\eta}_i = 0$	All tests jointly
Indonesia	0.492* (0.041)	0.147* (0.030)	not applicable	$F(2,221) = 471.7$*
Philippines	0.312* (0.030)	0.124* (0.025)	$F(4,215) = 5.96$*	$F(6,215) = 340.1$*

* indicates rejection of restriction at 1%.

[14] It should be noted that this result for Singapore differs from that found in Phylaktis and Kassimates (1994a). The following are some possible reasons for this difference. In the current paper, the exploitation of the weak exogeneity property leads to more efficient estimates; in addition the sample period is extended by four years. The careful treatment of the constant might also explain some of the other differences in the results between the two papers.

both Indonesia and the Philippines (i.e. $\rho_2 \approx 0.1$). The above result implies that the error correction mechanism, with the change in the official rate as the dependent variable, can be interpreted as a central bank reaction function responding to variations in the black market rate. This is consistent with a policy of targeting the real exchange rate in order to maintain external competitiveness and improve the balance of payments by using the black market rate as an indicator of anticipated prices since the latter is free to vary and maintain PPP.[15] Such a scenario fits the case of Indonesia, which tried to maintain the competitiveness of its non-oil exports by keeping its real exchange rate constant during the 1980s.[16]

VI. FINAL THOUGHTS

In conclusion, preconceptions about the division of the seven countries into two groups were largely confirmed by the results. The notable exception was Taiwan which seems to be surprisingly similar to Indonesia and the Philippines in its black market behaviour. This seems to be attributable mainly to the fact that the official exchange rate is reactive rather than exogenous. The implications of the portfolio model of black markets have had mixed fortunes. With the exception of Singapore, the prediction of stationarity in the black premium holds. The black market premium shows short-run predictability as one would expect for saddle-path dynamics. In two respects, the portfolio model fares badly. The official exchange rate is not even weakly exogenous for three of the seven countries. Finally, we obtain the result that the impact effect of an unanticipated devaluation is reflected immediately one-for-one in the black rate. These two results suggest that the portfolio model is an inadequate guide to the behaviour of black markets for foreign exchange.

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[15] Phylaktis and Kassimatis (1994b) show PPP to hold when using the black market rate for the Pacific Basin countries and for the same period.

[16] See Phylaktis (1995).