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Examining Foreign Exchange Behaviour in Asia Pacific and Eastern European Emerging Countries

Catherine S. F. Ho[a] and M. Ariff†

*This paper reports new findings on exchange rate dynamics concerning whether non-parity fundamentals and parity factors affect exchange rates within a group of trade-related emerging countries: non-parity fundamentals suggested by economic theories have yet been systematically related to exchange rates. We use high- and low-frequency multi-country pooled time series panel data approach. The evidence that emerges from this paper is that non-parity factors are significant contributors to exchange rates. These new findings on other-than-parity fundamentals add to a richer understanding of e*xchange rate behaviour as well as clarifying why existing findings are mixed.

Keywords: Exchange Rates, Parity Theorems, Trade and Capital Flows, Foreign Debt, Reserves, Growth, Monetary and Fiscal Policy.

JEL classification: F31, F32, C32, C33, C43

1.0 Introduction

The very mixed evidence on how exchange rate is determined in the world's largest financial market, namely the market for currencies, hampers any broad generalization about exchange rate behavior. In the light of the current mixed findings reported in the literature, this paper (a) tests the two parity theorems jointly, and (b) identifies the significant non-parity variables related to exchange rates. These results are obtained using a newer approach of testing for exchange rate equilibrium within a *trade-related* group of economies and the fixed effect panel data research design that maximizes the use of information in the data set.

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After much effort at studying exchange rates between pairs of countries that has yet provided reliable and consistent findings, newer approaches using multi-country framework with pooled time series panel data methodology is being applied by researchers. Meese and Rogoff (1983, 1988), MacDonald and Taylor (1992), Frankel and Rose (1996a) and Juselius and MacDonald (2004) pointed out that the omission of other fundamental variables in tests may have led to finding no relationship between parity theories and exchange rates. This study therefore aims to extend the literature by looking systematically at the contributions of parity *and* non-parity variables. The resulting findings can be expected to lead to a slightly improved understanding of the dynamics of how exchange rates are determined, by testing within trade-related multi-country context and by factors beyond traditional parity conditions. With a better understanding of the workings of exchange rates, multinationals and government policies can be geared towards management of financial and currency crises periodically experienced by many countries in recent decades. The remainder of this paper is divided into five sections. The next section contains a brief overview of the current literature relevant to this study. Section three describes the multi-country pooled time series panel model methodology, followed by the presentation of the findings in section four. The paper ends in section five with a conclusion.

2.0 Literature on Exchange Rate Determination

The currency exchange market is the world's largest market in terms of daily trading volume, in excess of US$1.9 trillion, which is far larger than even the world's combined bond or stock markets.[1] Imports and exports of goods and services, coupled with international capital flows could only account for some of these currency transactions. Trading of currencies takes place in foreign exchange markets throughout the world. The primary function of the market is to facilitate international trade *and* cross-border investments as well as to permit transfers of purchasing power denominated in one currency to another while interest rate differences are transferred via currency's exchange rates in open economies.

The two parity theorems of exchange rates include the Purchasing Power Parity (PPP of Cassel, 1918) as well as the Interest Rate Parity (IRP of Fisher, 1930). These theorems have been extensively tested by many renowned scholars all over the world. However, interest in currency behaviour is rekindled by the availability of newer statistical tools, as well as the accumulation of data over lengthy periods.

2.1 Parity Theorems

PPP has been viewed by many as a basis for international comparison of income and expenditures, an equilibrium condition; and efficient arbitrage condition in goods as a theory of exchange rate determination. PPP established a common

ground for cross-country comparison by linking currencies of different countries to price levels or more precisely price differences across countries as the base.
The underlying theory is based on a simple goods market arbitrage argument ignoring tariffs, transportation costs, and assuming common goods traded would ensure identical prices across countries, under the *law of one price*. While this notion appears simple enough, specifying comparative prices between two countries in the short run is difficult. This has led to a majority of empirical literature failing to verify that PPP holds.[2] The relative version of PPP suggests that if a country's inflation rate is relatively higher than its trading partner, that country will find its currency value falling in proportion to its relative price level increases. The change in exchange rate *E* is a function of price differentials, where *j* represents country, *t* represents time period, *P* represents prices, *d* domestic and *f* foreign:

$$\ln E_{jt} = a_j + b_j \ln\left(\frac{P_t^d}{P_t^f}\right)_j + \mu_{jt} \qquad (1)$$

With the obvious failure PPP to hold in the short run and years of high exchange rate volatility in the world, it seems that the theory of PPP had failed to hold during the 1970s and 1980s.[3] The apparent lack of evidence on PPP under the current floating regimes in several countries particularly acts as a motivating force that led to the development of the sticky price hypothesis, which is an over-shooting exchange rate model of Dornbusch (1976). Moreover, in the last two decades, given the low power of unit root tests for PPP, researchers often failed to reject the null hypothesis of the random walk in exchange rate with that approach.[4]

In their survey of PPP literature, Froot and Rogoff (1994) concluded that PPP is not a short-run relationship and that prices do not offset exchange rate swings on a monthly or even annual basis. Frankel and Rose (1996a) examined PPP using a panel of 150 countries for forty-five years and confirmed that PPP holds and their estimate implied a half-life of PPP deviations of *four years*. Further test using the more established cointegration approach failed to reveal support for equilibrium even in the long run for the same countries.[5] Further research using newer tests with a longer time span could provide robust findings and enhance our understanding of the exchange rate dynamics in a region of trade-related countries. Interest rate parity, IRP, is the law of one price in the asset market for securities.[6] In theory, the foreign exchange market should be in equilibrium when deposits of all currencies offer the same rate of return. According to the uncovered interest rate parity, the ratio of changes in exchange rate *E*, within a time period *t,* is a function of domestic interest rate i^d, and foreign interest rate i^f.

$$\frac{E_{t+1}}{E_t} = \left(\frac{1 + i_t^d}{1 + i_t^f}\right) \qquad (2)$$

If the real rates of interest are equalised across the world through capital mobility, then nominal interest rate difference must reflect differences in expected inflation rates of countries under conditions of similar country risk. The ability of exchange

rate markets to anticipate interest differentials is supported by several empirical studies that indicated the long run tendency for these differentials to offset exchange rate changes.[7]

2.2 Non-Parity Variables

The previous two parity theories with strong assumptions of equal country risk and zero transaction costs, as well as no other factors entering the equilibrium, have long been maintained as the two premier theories of exchange rate determination. However, researchers have pointed out, over the last two decades, that there are other variables which are correlated with exchange rate movements as predicted by mainstream economic theories.[8] Inclusion of these variables could shed new light, as other-than-parity factors to explain exchange rate behavior. Parity explanations gained centre stage up until the end of 1980s, but in recent years one could witness interests in other explanations, given the conflicting empirical evidence on parity theories.

2.2.1 Current and Capital Account Deterioration

Exchange rate determination has been linked only to parity conditions as in Cassel (1918), Keynes (1923) and Fisher (1930), or trends in productivity as in Balassa (1964) and Samuelson (1964). Studies of financial crises in Latin America and East Asia have been motivated by an interest in the roles of banking, and balance of payments. It has been inferred in Kaminsky and Reinhart (1999) that, following the liberalization of financial markets, banking sector problems preceded balance of payment crises leading to currency crises. For countries affected by the 1997/8 Asian financial crisis, the reversal of capital flows, and current account deficits (together with high foreign debt) have been common factors surrounding exchange rate collapses. Therefore these variables should have tremendous impact on exchange rates.[9] The impact of current account on exchange rate has long been very cursory. Trade liberalization has introduced volatility in the balance of payments, and the increase in current account flow directly affects currencies. Trade in goods accounts for more than 60 percent of GDP in East Asia and the Pacific developing countries; and the corresponding number is more than 65 percent of GDP for Europe and Central Asian developing countries.[10] Therefore, trade appears to be another important factor.

Karfakis and Kim (1995) using Australian exchange rates found that unexpected current account deficits which is the net effect of trade, is associated with a depreciation of exchange rates and a rise in interest rates. Evidence that current account deficits diminished domestic wealth and led to overshooting of the exchange rates are also reported by Obstfeld and Rogoff (1995), Engel and Flood (1985), and Dornbusch and Fisher (1980). There has also been a surge in international capital flows into developing countries in the recent decades.[11] Sudden outflow of capital is another major concern when it drastically affects exchange rates as were seen during the financial crises of Brazil, East Asia, and

Mexico. These capital flows affect domestic output, real exchange rates, capital and current account balances for years thereafter.[12] Calvo, Izquierdo and Talvi (2003) blamed the fall of Argentina's currency peg on the vulnerability to sudden stops in capital flows. A study by Kim (2000) on four countries that faced currency crises found that reversal of capital flows as well as current account deficits are significantly related to currency crises in these countries. Rivera-Batiz and Rivera-Batiz (2001) concluded that explosion of capital flows resulted in higher interest rates and depreciation of exchange rates in the long run. Capital inflows especially of the *hot money* variety may reverse on short notice and possibly lead to adverse effects on currency value. Studies indicate that the surge of capital flows in the East Asian region during the first half of the 1990s and their swift reversal in 1997 was at least the direct proximal cause of the financial crisis.[13]

2.2.2 Loss of International Reserves and Excessive Foreign Currency Debt

The amount of international reserves held by the monetary authority is another factor affecting exchange rate determination.[14] Due to the usage of reserve as a mean to defend a country's currency, it provides credibility to currency value. This study aims to test for significant results in this area. Calvo, Leiderman and Reinhart (1994) showed that increase in capital inflows increase total reserves and real exchange rates of Latin American countries. Marini and Piersanti's (2003) study covering Asian countries found that a rise in current and expected future budget deficits generated appreciation in exchange rates and a decumulation of external assets, resulting in a currency crisis when foreign reserves fell to a critical level. Hsiao and Hsiao (2001) found a unidirectional causality from short-term external debt/international reserves ratio to exchange rates in Korea. Similar to Martinez (1999) on Mexico, Frankel and Rose (1996b) studied a large group of developing countries and found that the level of debt, foreign direct investment, foreign interest rates, foreign reserves and growth rates affect exchange rates significantly.

2.2.3 Trade Openness, Slow Growth, Fiscal Imbalances, and Excessive Monetary Expansion and Exchange Rate Regime

Globalization has resulted in domestic financial markets being exposed to the flows of capital to and from international financial markets. Open economy's domestic interest rates tend to reflect not only domestic conditions but also international conditions namely the prevailing world interest rate, after allowing for currency risk: see Edwards and Khan (1985) and Ariff (1996). Open economies facing capital flows, competitive interest rates and trade competition from others must lead to a defined relationship between openness and the rate of growth in some countries.[15] Papell and Theodoridis's (1998) study on openness, exchange rates and prices found stronger evidence of PPP for countries with less exchange rate volatility, and shorter distance from other countries but not for countries with greater openness to trade. Theoretically, price level, output and exchange rates are affected by changes in monetary policy. Karras (1999) using annual data for a

panel of 38 countries reported results supporting the theoretical predictions: the more open the economy, the smaller the output effect, and the larger the price and exchange rate effects of a given change in the money supply.

Among the many models found in the literature to explain long-term deviations in PPP, the most popular one with a long lasting interest are those of Balassa (1964) and Samuelson (1964). Both agued that technological progress has historically been faster in the traded goods sector than in non-traded goods sector and therefore traded goods productivity bias is more obvious in higher income countries. Rogoff (1999) further showed that faster growing countries would tend to experience exchange rate appreciation relative to their slower growing partners when technological changes happen more often in trading goods sector as a result of intense international competition. Froot and Rogoff (1994) showed that relative differences in the rate of technological change could result in changes in factor prices, causing deviations in prices and exchange rates.[16]

Using a panel of OECD countries, Canzoneri, Cumby and Diba (1999) found that when relative productivity of traded goods grew more rapidly in Italy and Japan than in Germany, both lira and yen appreciated in real terms against Deutschemark. Another study by Chinn (2000) provided evidence on productivity explanation for long-run real exchange rate movements in East Asia including Japan, Indonesia, Korea, Malaysia and Philippines but not for Singapore, China, Thailand and Taiwan. Duval's (2002) paper showed that the Balassa-Samuelson effect and other determinants of the relative price of non-tradable goods are important drivers of the real exchange rates in developing countries because contribution of relative prices of tradable goods is much greater than contribution from non-tradable goods in these countries. Cheung, Chinn and Pascual (2003) found that productivity model worked well for the mark-yen exchange rates but the same conclusion cannot be applied to all others.

Since the breakdown of the fixed exchange rate under Bretton Woods system, exchange volatility has drastically increased to levels that are beyond the explanation of fundamentals. Different exchange rate management regimes allow for different degrees of volatility and higher exchange rate volatility is expected in flexible systems. However, Grilli and Kaminsky (1991) concluded that real exchange rate behaviour changes substantially across historical periods but not necessarily across exchange rate regimes. Calvo and Reinhart (2002) examining 39 countries around the world found that moderate to large exchange rate fluctuations are very rare in managed float systems. Hasan and Wallace's (1996) study of a hundred years of data found that real exchange rate volatility is greater for flexible exchange rate periods than fixed exchange rate periods but is not significantly exclusive. Moosa and Al-Loughani (2003) showed that exchange rate arrangement, as well as fundamentalists and technicians, play an important role in the determination of exchange rates. Edwards (2002) explained that super-fixed regimes (example: China in 2005) were highly inflexible and inhibited adjustment

process but it is often chosen as the only feasible exchange regime by emerging economies.

3 Data, Methodology and Summary Statistics

3.1 Data

The data relate to exchange rates between individual countries, and the United States (U.S.) dollar (IFS line rf) as the foreign unit observed at end of observation periods sourced from the *International Financial Statistics* (IFS) CD-ROM. Price variables include CPI (IFS line 64) and PPI (IFS line 63) of individual countries; T-Bill and Money market rates (IFS line 60) are used to arrive at the interest differentials between countries. Changes in exchange rates, prices and interest differentials are calculated using natural logarithm.

Parity Variables

Consumer Price Index (CPI) measures the consumer price of a basket of goods available in each country. Wholesale Price Index (WPI) measures the wholesale price of a basket of the country's goods. It is believed that the latter is a better proxy when countries do engage in market intervention to gain advantage in trade. The proxy used to test *interest* parity is the domestic short-term money market interest rate, depending on the availability of data from each country, all of which closely reflect interest rate movements. U.S. short term Treasury-bill rate is the foreign interest rate for measuring interest differentials between countries.

Non-Parity Variables

The non-parity current and capital flow variables include: trade balance (Trade) from imports and exports of goods, current account balance (Cur), balance of payments (BOP) from overall balance, capital flows include both inflows and outflows of foreign direct investment (FDI) and portfolio investments (Pt), total reserves (TRes) as well as foreign debt (FD). Monetary expansion data is broader money (M2) which includes both money and quasi-money. Growth rate (Prodty) is measured by change in Gross Domestic Product (GDP) per capita. The set of dummy variables includes exchange regimes which are grouped into three categories: free-float, exchange band/managed, and fixed regime. Trade openness is measured by total trade (TTrade), that is, the sum of total imports and exports, as a proportion of GDP. Incomplete data are sourced from DataStream, World Bank as well as individual country's Central Banks and Statistical Departments. The independent variables are categorised into parity and non-parity variables. A summary of variable definitions and their expected signs are found in Table 1.

Table 1: Summary of Variables and Definitions

No.	Variable	Definition	Expected Sign
1.	LnER	Log difference of Exchange Rate over time periods	
2.	LnP	Log difference of Prices over time periods	+
3.	LnI	Log difference of Interest Rate over time periods	+
4.	Trade/GDP	Trade Balance / Gross Domestic Product (GDP)	-
5.	Cur/GDP	Current balance / GDP	-
6.	BOP/GDP	Balance of Payment / GDP	-
7.	TRes/M	Total Reserve / Total Import	-
8.	FD/GDP	Foreign Debt / GDP	+
9.	InFDI/GDP	Inflows of Foreign Direct Investment / GDP	-
10.	OutFDI/GDP	Outflows of Foreign Direct Investment / GDP	-
11.	InPt/GDP	Inflows of Portfolio Investment / GDP	-
12.	OutPt/GDP	Outflows of Portfolio Investment / GDP	-
13.	Bdgt/GDP	Budget Deficit or Surplus /GDP	-
14.	TMy/GDP	Total Money (M2) / GDP	+
15.	Prodty	Gross Domestic Product / Total Population	-
16.	TTrade/GDP	Total Exports and Imports / GDP	-
17.	Regime	Exchange Regime	+ or -

The sample in this study includes eight countries in the Asia Pacific region: Australia, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore and Thailand and eight countries in the Eastern European region: Czech Republic, Hungary, Poland, Romania, Russia, Slovak, Slovenia and Turkey as shown in Table 2. The reasons behind the choice countries are the high level of inter-trade between countries in the similar geographical region and the availability of information with these nations.

Table 2: Data Length for the Two Regions of Countries

The study includes countries in two trade-related regions with: eight countries in the Asia Pacific region and eight countries in the Eastern Europe region.

Region	Asia Pacific	Eastern Europe
No. of countries	8	8
Quarterly	1978:1 – 2005:1	1993:1 – 2005:1
Yearly	1978 - 2004	1993 – 2004

3.2 Pooled Series Panel Model

Both seemingly unrelated regression (SUR) and fixed effect (FE) pooled data models are employed to investigate exchange rate behaviour. SUR allows cross-

sectional variations in the data set, and thus yields robust estimates of the test statistics according to Zellner, 1962. As a system of equations, this method can be applied here rather than estimating the equation in one cross section, which would be wasteful as it would leave out information in the data set. SUR is estimated using generalised least squares algorithm. Since SUR technique utilises information on the correlation between the error terms, the resulting estimates are more precise than estimates from least squares: it also yields lower standard errors and higher R^2.

More recent studies have also concentrated on longitudinal data set. These panel data sets are more oriented toward cross-sectional analyses. Panel data provides a richer environment for the development of estimation techniques with robust test results. It allows the use of time-series cross-sectional data to examine issues that could not be studied in either cross-section or time-series settings alone. By allowing cross-sectional variation or heterogeneity to affect estimations, the resulting estimates are robust. We use the fixed effect approach here because it permits the constant term to be the country-specific variations in the regression as stated in Greene, 2003. This is referred to as the least squares dummy variable (LSDV) model. The random effect model is not appropriate for our tests. We also assume that the issue of ambiguous relationship may be minimised through the use of instrumental-variables (IV) regression. The Hausman (1978) test statistics proposed by Davidson and MacKinnon (1993) for endogeneity is applied.

In summary, the analysis of the determinants of exchange rates is carried out by estimating the pooled data regressions as follows:

$$\ln ER_{jt} = a'_0 D_j + a'_{1j} \ln\left(\frac{P}{P*}\right)_{jt} + b'_{1j} \ln\left(\frac{I}{I*}\right)_{jt} + c'_{1j}\left(\Delta Trade/GDP\right)_{jt} + c'_{2j}\left(\Delta Cur/GDP\right)_{jt} +$$
$$c'_{3j}\left(\Delta BOP/GDP\right)_{jt} + c'_{4j}\left(\Delta InFDI/GDP\right) + c'_{5j}\left(\Delta OtFDI/GDP\right) + c'_{6j}\left(\Delta InPt/GDP\right)_{jt} +$$
$$c'_{7j}\left(\Delta OtPt/GDP\right)_{jt} + c'_{8j}\left(\Delta FD/GDP\right) + c'_{9j}\left(\Delta T\mathrm{Res}/GDP\right) + c'_{10j}\left(\Delta \mathrm{Pr}odty\right)_{jt} +$$
$$c'_{11j}\left(\Delta Bdgt/GDP\right)_{jt} + c'_{12j}\left(\Delta TTrade/GDP\right)_{jt} + c'_{13j}\left(\Delta TMy/GDP\right)_{jt} + c'_{14j}(\mathrm{Re}gime)_{jt} + v'_{ij} \quad (3)$$

In the above equation, the subscript *j* represents a country in the sample, while *t* denotes the number of time periods (quarterly, yearly, two yearly and so on respectively). The fixed effect approach allows the constant term to vary from one cross-section unit to another (the LSDV model). This helps to control for unobserved components of country heterogeneity (through having country-specific constant terms) that may in fact drive both exchange rates and other country characteristics included in the regressions. Common problems faced in cross-sectional and time series analysis are non-normality of variables, non-stationarity of time series data, multicollinearity among criterion factors, autocorrelation and heteroscedasticity. The impact of multicollinearity is to reduce any single independent variable's predictive power by the extent to which it is associated with the other independent variables. It can be detected using Variance Inflation Factor (VIF) that shows how the variance of an estimator is inflated by the presence of

multicollinearity in Table 3 (Hair *et al.*, 1998). Variables with larger VIF values or low tolerance level are excluded: alternatively highly collinear variables may be joined in some transformation of the series.

Table 3: Non-Parity Variables VIF and Tolerance Measure for Asia Pacific and Eastern Europe

	Asia Pacific		Eastern Europe	
Variables	**VIF**	**Tolerance**	**VIF**	**Tolerance**
LNP	1.05	0.95	1.68	0.60
LNI	1.06	0.95	1.81	0.55
Trade/GDP	3.0	0.33	3.87	0.26
Cur/GDP	2.94	0.34	3.86	0.26
BOP/GDP	1.56	0.64	2.80	0.36
InFDI/GDP	1.35	0.74	1.18	0.85
OutFDI/GDP	1.59	0.63	1.10	0.91
InPt/GDP	1.84	0.54	1.99	0.50
OtPt/GDP	1.18	0.85	1.23	0.81
TRes/IM	1.45	0.69	2.06	0.49
Bgt/GDP	1.17	0.85	1.33	0.75
TMy/GDP	1.28	0.78	1.96	0.51
PROD	1.13	0.88	2.05	0.49
FD/GDP	1.14	0.88	1.38	0.72
TTrade/GDP	1.27	0.79	1.73	0.58
Regime	1.16	0.87	1.59	0.63

* VIF values of more than 10 shows significant multicollinearity.

Table 4: Unit Root Tests for Parity and Non-Parity Variables for Asia Pacific

Variables	Asia Pacific			Eastern Europe		
	ADF Test		KPSS Test	ADF Test		KPSS Test
	t-stats	Model (lag)	KPSS statistic	t-stats	Model (lag)	KPSS statistic
lnER	-6.72***	C(0)	0.77***	-11.76***	C(0)	0.43*
lnP	-3.16***	None	0.12	-1.51	C(4)	0.16
lnI	-7.26***	C(0)	0.11	-6.93***	C(2)	0.42*
Trade/GDP	-6.31***	C(19)	0.49**	-6.35***	C(7)	0.13
Cur/GDP	-7.24***	C(15)	0.26	-8.58***	C(6)	0.13
BOP/GDP	-25.93***	C(2)	0.12	-15.24***	C(2)	0.15
InFDI/GDP	-14.38***	C(10)	0.10	-26.67***	C(0)	0.11
OutFDI/GDP	-10.12***	C(19)	0.04	-8.86***	C(7)	0.10
InPt/GDP	-6.81***	C(20)	0.03	-15.96***	C(2)	0.10
OutPt/GDP	-4.13***	C(18)	0.02	-7.52***	C(7)	0.38*
TRes/IM	-25.74***	C(0)	0.21	-14.30***	C(0)	0.03
Bdgt/GDP	-11.09***	C(7)	0.09	-16.99***	C(2)	0.08
TMy/GDP	-28.54***	C(0)	0.07	-11.48***	C(6)	0.13
Prodty	-8.88***	C(11)	0.08	-11.13***	C(6)	0.17
FD/GDP	-7.19***	C(3)	0.10	-14.70***	C(2)	0.06
TTrade/GDP	-5.82***	C(11)	0.07	-8.35***	C(6)	0.25

Critical values for ADF tests at 10,5 and 1% levels of significance are respectively, -2.59, -2.90 and –3.53 with a constant and –3.17, -3.48 and –4.09 with a constant and a deterministic trend. Critical values for KPSS tests at 10, 5 and 1% levels of significance are respectively, 0.35, 0.46 and 0.74 with a constant and 0.12, 0.15 and 0.22 with a constant and a linear trend.

Note: For the ADF tests, the unit root null is rejected if the value of the ADF t-statistics is less than the critical value. For the KPSS tests, the null of stationarity is rejected if the value of the KPSS statistic is greater than the critical value. *, ** and *** denote statistical significance at 10, 5 and 1% level. The critical values for the ADF tests are from MacKinnon (1991).

The normality of all the variables will be tested to ensure multivariate normality and this is further ensured by specifying the variables in natural logarithms while stationarity of the series will be tested and confirmed by Augmented Dickey-Fuller (ADF) unit root test and the Kwiatkowski, Philips, Schmidt and Shin (KPSS) Test in Table 4. The presence of heteroscedasticity is detected by White's test using Eviews software. To ensure that the assumption of constant variance is not violated, the heteroscedasticity and autocorrelation problems are tested and corrected.

4 Findings

4.1 Asia Pacific

The results from SUR and fixed effect models for the Asia Pacific countries are summarized in Table 5. There is no significant evidence of price parity even up to three-year intervals. However, interest parity is holding for two and three-year intervals, an improved result. Increase in interest rates in these countries results in a fall in domestic currency value in the longer term. The coefficient for interest rate is statistically significant (t-statistics of 3.95 and 2.57 for SUR and fixed effects respectively at three-year intervals) for both the models. With the longer term of two and three-year intervals, fixed effect and SUR model shed more light in explaining the movements of exchange rates by demonstrating statistical significance for a larger number of non-parity variables. Those non-parity fundamentals which are significant in the short term (quarterly intervals) include overall balance of payments, accumulation of foreign debt, growth rate, fiscal budget balance and monetary expansion.

Growth rate continues to be the most statistically significant determinant of changes in exchange rates from the very short term of quarterly and even up to the longer run of three-year intervals (t-ratios of -3.52 and -5.35 respectively for SUR and fixed effects models). Improvement in growth rates is directly related to domestic currency value. Furthermore, improvement in balance of payments, surplus fiscal budget balance and monetary expansion also significantly improve the exchange value of the domestic currency in the shorter term. Similar to findings in the previous one and two-step models, foreign debt (t-statistics of 2.38 and 1.61 for SUR and fixed effects respectively) is only a short term measure (significant at quarterly intervals) in affecting exchange rates where excessive government's foreign borrowing is indirectly associated with exchange rates which is consistent with theoretical beliefs.

New findings from SUR and fixed effect models thus show significance of trade openness in the very short term (t-ratios of 2.33 and 1.96 for SUR and fixed effects model respectively at quarterly intervals). Openness to trade allows more imports to be sucked into these countries therefore deteriorating their exchange value, a capital-hungry region. This might be due to rapid expansion of production facilities where large amounts of technology and industry imports are needed to sustain long term growth in this mixed group of countries.

Table 5: SUR and Fixed Effects Results for the Asia Pacific

Asia Pacific		Quarterly		Yearly		2 Yearly		3 Yearly	
		SUR♣♦	Fixed effects♠#	SUR♣♦	Fixed effects♠#	SUR♣♦	Fixed effects♠#	SUR♣♦	Fixed effects♠#
Intercept		.020	.019	.076	.078	.055	.012	.178	.060
		(8.33)*	(4.63)*	(5.84)*	(5.08)*	(1.78)***	(0.22)	(2.39)**	(0.64)
Parity	Price	-.011	-.011	-.008	-.017	-.010	-.059	-.004	-.036
		(-2.34)**	(-1.52)	(-0.80)	(-1.27)	(-0.33)	(-0.81)	(-0.07)	(-0.62)
	Interest	.025	.029	.127	.373	.665	.697	1.440	1.348
		(0.82)	(0.82)	(1.33)	(2.51)*	(3.21)*	(1.94)***	(3.95)*	(2.57)*
Non-Parity	Trade/ GDP	.020	.003	.099	.005	.087	-.099	.954	.819
		(0.21)	(0.03)	(0.61)	(0.04)	(0.41)	(-0.42)	(2.64)*	(2.94)*
	BOP/ GDP	-.078	-.074	-.355	-.359	-.166	-.098	.125	.397
		(-2.51)*	(-1.25)	(-3.50)*	(-2.77)*	(-0.90)	(-0.37)	(0.26)	(2.34)**
	Cur/ GDP	.081	.097	-.063	-.071	.234	.286	-.377	-.500
		(1.11)	(1.10)	(-0.41)	(-0.42)	(1.22)	(1.34)	(-1.09)	(-1.32)
	InFDI/ GDP	.011	.012	.254	.203	.185	.516	.992	.142
		(0.22)	(0.24)	(1.28)	(0.76)	(0.53)	(1.19)	(1.40)	(0.16)
	OutFDI/ GDP	-.010	-.024	.350	.585	-.123	.104	-	-
		(-0.09)	(-0.32)	(1.08)	(1.81)***	(-0.26)	(0.24)		
	InPt/ GDP	-.035	-.044	.028	-.009	-.235	.158	-.305	-1.098
		(-0.89)	(-0.98)	(0.17)	(-0.05)	(-0.52)	(0.27)	(-0.44)	(-2.61)*
	OutPt/ GDP	-.001	-.010	.239	.216	-.106	-.210	-	-
		(-0.01)	(-0.08)	(1.14)	(0.92)	(-0.24)	(-0.32)		
	TRes/ Im	.006	-.003	.011	.044	-.062	-.055	-.272	-.395
		(0.54)	(-0.29)	(0.13)	(0.43)	(-0.64)	(-0.35)	(-1.93)***	(-2.61)*
	ForDt/ GDP	.096	.112	-.131	-.129	-.146	.129	-	-
		(2.38)**	(1.61)***	(-0.70)	(-0.60)	(-0.72)	(0.46)		
	Prodty	-54.115	-53.080	-26.457	-29.567	-30.339	-34.925	-21.129	-21.543
		(-28.90)*	(-22.23)*	(-7.94)*	(-6.90)*	(-8.47)*	(-5.61)*	(-3.52)*	(-5.35)*
	Bdgt/ GDP	-.079	-.075	.325	.307	.274	.336	-.332	-.555
		(-2.66)*	(-2.59)*	(1.93)***	(1.37)	(1.43)	(0.89)	(-0.66)	(-1.02)
	TMy/ GDP	-.254	-.253	-.761	-.780	-.435	-.491	-.690	-.573
		(-31.74)*	(-14.01)*	(-14.08)*	(-11.73)*	(-6.90)*	(-4.02)*	(-4.89)*	(-5.59)*
	Regime	-.002	-.001	-.001	-.002	.041	.078	.001	.092
		(-1.60)	(-0.49)	(-0.07)	(-0.23)	(2.35)**	(2.30)**	(0.03)	(1.31)
	TTrade/ GDP	.073	.084	.051	.043	.022	.011	.059	.095
		(2.33)**	(1.96)**	(2.47)**	(1.47)	(0.88)	(0.27)	(1.03)	(1.70)***
	Adj R^2	0.863	0.856	0.883	0.884	0.866	0.889	0.745	0.816
	F-prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The number of observations for SUR and Fixed effects is lower due to Singapore which consolidate FDI and Portfolio flows into one, Indonesia without data until the late 90's and Malaysia without data for portfolio flows until the 90's. ♣Pooled General Least Squares with Cross-section SUR that estimates a feasible GLS specification correcting for both cross-section heteroscedasticity and contemporaneous correlation. ♠Fixed effects Pooled GLS with cross section weights where Eviews estimates a feasible GLS specification assuming the presence of cross-section heteroscedasticity. #With White's cross-section standard errors & covariance correction by treating pooled regression as a multivariate regression with an equation for each cross section and computing White-type robust standard errors for the system of equations. ♦With cross-section SUR (PCSE) using Panel Correlated Standard Error methodology standard errors & covariance correction. Numbers in parentheses are t-statistics. *, **, *** represent 1%, 5%, 10% significance level respectively. F-prob represents F-probability values and Adj R^2 represents adjusted R-squared values.

In the longer term for this region of mixed status countries, growth rate, monetary expansion and trade openness continue to be statistically significant in determining exchange rates. New findings from SUR and fixed effects models include inflows of portfolio investment and accumulation of reserves as long term determinants when the coefficients are of the correct sign and statistically significant (t-ratios of -1.93 and -2.61 respectively) at three-year intervals: again robust results. The adjusted R-squared values for the models for all time periods are above 75 percent and this means that the models can explain more than seventy-five percent of changes in exchange rates. Moreover, the probabilities of F-ratio for these models are all very low indicating very good model fit. In summary, balance of payments, accumulation of foreign debt, growth rate, budget balance, trade openness and monetary expansion are significant determinants of exchange rates for the shorter time interval. For the longer term, not only do growth rate, trade openness and monetary expansion continue to be significant but accumulation of reserves, portfolio flow and interest parity coefficients are statistically significant according to these models.

4.2 Eastern Europe

From the results of quarterly, and one to three-year intervals for the Eastern Europe region of countries in Table 6, the coefficient for interest rate is statistically significant for all time period intervals from the short to long run (t-ratios of 8.08 to 2.88 from quarterly to three-year intervals). Nevertheless, the price coefficient is not of the expected sign as explained by PPP and insignificant for all time periods. Thus for the region of developing countries in Eastern Europe, interest parity is holding but price parity is not found to be statistically significant, probably due to the slow adjustment of prices to exchange rates and the short data period available from 1994. Since most of these countries are newly formed, when a lengthier time period is available in the future, later studies might be able to furnish us with more theoretical significant results.

The role of non-parity fundamentals cannot be ignored both in the short as well as the longer term. Quarterly trade balance is statistically significant (t-statistics of -2.33 and -1.82 respectively for SUR and fixed effects respectively) in affecting exchange rates in the shorter period where improvement in trade improves the value of the domestic currency. Government's monetary expansion also plays an important part in influencing exchange rates in the shorter term when monetary expansion is needed to sustain rapid economic growth resulting in a positive effect on domestic exchange rates.

Table 6: SUR and Fixed Effects Results for Eastern Europe

Eastern Europe		Quarterly		Yearly		2 Yearly		3 Yearly	
		SUR♣♦	Fixed effects♠#	SUR♣♦	Fixed effects♠#	SUR♣♦	Fixed effects♠#	SUR♣♦	Fixed effects♠#
Intercept		.031	.052	-.010	.008	.246	.420	.414	-28.282
		(2.30)**	(2.55)*	(-0.26)	(0.10)	(3.69)*	(3.42)**	(3.86)*	(-6.02)**
Parity	Price	-.001	-.011	.022	-.025	-.020	-.130	-.108	-.015
		(-0.54)	(-2.44)**	(1.16)	(-0.72)	(-1.05)	(-3.97)*	(-1.10)	(-0.11)
	Interest	.178	.166	.856	.502	2.012	1.366	3.234	2.813
		(7.69)*	(8.08)*	(9.63)*	(2.82)*	(11.89)*	(3.58)**	(7.86)*	(2.88)***
Non-Parity	Trade/GDP	-.452	-.310	-.235	.250	.220	2.482	-	-
		(-2.33)**	(-1.82)***	(-0.22)	(0.25)	(0.26)	(2.09)***		
	BOP/GDP	.019	.002	.530	-.203	1.580	-1.706	2.012	3.228
		(0.23)	(0.03)	(1.20)	(-0.46)	(1.62)***	(-2.35)***	(2.95)*	(3.98)***
	Cur/GDP	.275	.230	-1.031	-.106	-1.170	-1.360	-.001	-2.022
		(1.42)	(1.53)	(-0.90)	(-0.15)	(-0.59)	(-1.15)	(-0.50)	(-6.02)**
	InFDI/GDP	.246	.318	-.903	.046	-.122	-2.565	-.001	4.520
		(1.48)	(1.95)**	(-0.94)	(0.07)	(-0.14)	(-1.66)	(-2.98)*	(5.86)**
	OutFDI/GDP	.005	.026	-2.642	10.769	-1.272	-24.782	-	-
		(0.04)	(0.15)	(-0.83)	(1.40)	(-0.38)	(-2.98)**		
	InPt/GDP	-.148	-.092	-.033	-.592	-2.162	-1.610	.001	-4.713
		(-1.29)	(-0.93)	(-0.04)	(-0.64)	(-1.52)	(-3.60)**	(0.66)	(-4.92)**
	OutPt/GDP	-.121	-.030	.646	1.930	-1.240	-3.120	-	-
		(-0.30)	(-0.09)	(0.48)	(2.42)**	(-0.69)	(-5.85)*		
	TRes/Im	.004	-.012	.256	.278	-.075	.699	-.360	-1.610
		(0.08)	(-0.29)	(0.80)	(1.10)	(-0.26)	(3.51)**	(-1.02)	(-2.10)
	ForDt/GDP	-.013	-.071	-2.720	-.112	-	-	-	-
		(-0.11)	(-0.90)	(-2.12)**	(-0.09)				
	Prodty	19.719	-101.818	-83.983	-141.422	-102.345	45.626	-123.455	-182.908
		(1.02)	(-2.66)*	(-2.67)*	(-5.19)*	(-2.65)**	(0.48)	(-5.12)*	(-7.76)*
	Bdgt/GDP	-.148	-.072	2.704	1.780	-	-	-	-
		(-2.15)**	(-0.90)	(5.23)*	(1.90)***				
	TMy/GDP	-.669	-.528	-.671	-.230	-.230	-2.190	-	-
		(-16.02)*	(-4.76)*	(-1.86)***	(-0.54)	(-0.48)	(-1.88)		
	Regime	.004	.002	.068	.091	-.052	-.120	-	-
		(0.36)	(0.22)	(2.24)**	(2.02)***	(-1.38)	(-2.62)**		
	TTrade/GDP	.065	.115	-.197	.009	-.309	-.376	-.350	1.527
		(1.18)	(1.83)***	(-1.26)	(0.05)	(-3.22)*	(-1.02)	(-1.14)	(1.16)
	Adj R^2	0.807	0.822	0.928	0.950	0.954	0.965	.982	0.790
	F-prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167

The number of observations for SUR and Fixed effects is lower due to Hungary without full data until 1995, Poland without portfolio outflows data until and incomplete data for Slovakia from 2001. ♣Pooled General Least Squares with Cross-section SUR that estimates a feasible GLS specification correcting for both cross-section heteroscedasticity and contemporaneous correlation. ♠Fixed effects Pooled GLS with cross section weights where Eviews estimates a feasible GLS specification assuming the presence of cross-section heteroscedasticity. #With White's cross-section standard errors & covariance correction by treating pooled regression as a multivariate regression with an equation for each cross section and computing White-type robust standard errors for the system of equations. ♦With cross-section SUR (PCSE) using Panel Correlated Standard Error methodology standard errors & covariance correction. Numbers in parentheses are t-statistics. *, **, *** represent 1%, 5%, 10% significance level respectively. F-prob represents F-probability values and Adj R^2 represents adjusted R-squared values.

Trade openness has negative relation with exchange rates in the shorter period of quarterly intervals (t-ratio of 1.83) but positive relationship with exchange rates in the longer period of two-year intervals (t-ratio of -3.22). Growth rate is also a statistically significant variable in the determination of exchange rates in the longer term where faster growth rates strengthen the domestic exchange rates especially after taking into consideration individual country effects in the fixed effect model (t-statistics of -5.12 and -7.76 for SUR and fixed effects at three-year intervals). Fiscal budget balance is marginally significant in influencing exchange rates at one-year intervals however budget surplus corresponds to a fall in currency value which is inconsistent with theoretical understanding. The other fundamentals including balance of payments, capital flows, and accumulation of reserves are insignificant in affecting exchange rates in the shorter term.

In the longer term for this region of developing countries in Eastern Europe, interest parity continues to hold and higher interest rates deteriorate the value of the domestic currency in accordance with IRP. The coefficients for current account and portfolio inflows are positively related to exchange rates and are statistically significant in three-year intervals. Conversely, foreign debt and accumulation of reserves are not only of the incorrect sign but also insignificant in determining exchange rates in this region. Growth and interest rates continue to be statistically significant in the longer period in affecting the currency values of these countries. On the other hand, monetary expansion and trade openness do not continue to be influential in the longer run. In summary, interest rate, current account balance, capital flows and growth rate are major driving forces of exchange rates in the longer term. However in the interim periods of one and two-year intervals, other non-parity variables including budget, monetary expansion and trade openness are marginally significant in determining exchange rates.

5.0 Conclusion

The results presented in this paper make a modest contribution to extend the literature on exchange rate behaviour for two regions of trade related emerging economies by considering the extent to which parity *and* non-parity variables influence the movements of exchange rates systematically. The results are robust as these are obtained from pooled panel data to test the theories for a group of *trade-related* countries. We find that, for the region of Asia Pacific countries in the long run, non-parity fundamentals such as (1) monetary expansion, (2) accumulation of reserves, (3) growth rate and (4) trade openness provide explanation for movements in exchange rates. Interest parity is also found to be holding in the longer term for both groups of countries: the method of SUR and fixed effects models appear to yield such robust result. PPP does not hold in the short run, which is consistent with prior empirical findings. For the region of Eastern European countries, non-parity fundamentals including (1) growth rate, (2) current account balance and (3) capital flows are significant drivers of exchange rates. We believe the tests developed in this study led to improved results, helped to identify new fundamentals that are related to exchange rates while the puzzle of

the short term versus long term behaviour is made obvious by applying different data frequencies from quarterly to several years.

Endnotes:

[1] BIS report including Central Bank Survey of Foreign Exchange and Derivative Market Activity 2004.
[2] Empirical work that has led to conflicting empirical findings for PPP includes MacDonald (1993), Rogoff (1996), Edison, Gragnon and Melick (1997), Cheng (1999) and Bayoumi and MacDonald (1999). They have all found no clear evidence or at best, very weak relationship between inflation and exchange rates.
[3] Henry and Olekaln's (2002) study on Australia found little evidence for long run equilibrium between exchange rate and prices. In a similar view, Adler and Lehman (1983) found that the deviations from PPP follow a random walk without reverting back to PPP for 43 countries. Sertelis and Gogas (2004) also found contradictory evidence on PPP for a number of industrial countries.
[4] Kuo and Mikkola (2001), Lothian and Taylor (2000), Mark and Sul (2001), Schnabl and Baur (2002) found considerable evidence for long run relation and concluded that fundamentals play a significant role in determining exchange rates.
[5] Other studies that found evidence in support of PPP includes Taylor and Taylor (2004) and Sarno, Taylor and Chowdhury (2004). Baharumshah and Ariff (1997) failed to provide results for PPP with cointegration tests in their study.
[6] The interest rate theory was first developed by Keynes (1923) and Fisher (1930) through the introduction of Fisher effect for domestic interest rate theory.
[7] Studies that provided evidence include Mark (1995), Chinn and Meredith (2002), Hoffman and MacDonald (2003) and Ehrmann and Fratzscher (2005) which found measures of long run expected changes in exchange rates highly correlated with interest rate differentials.
[8] Frankel and Rose (1996b) on current account and government budget deficits; Calvo, Leiderman and Reinhart (1994) on capital flows, inflation and current account deficits; and Aizenman and Marion (2002) on reserve and credibility; and many others.
[9] It is documented that the recent currency crises were due to vast changes in these variables, including Kim (2000).
[10] *2005 World Development Indicators*, World Bank, 2005.
[11] Gross foreign direct investment as a percentage of GDP increased more than 100 percent for Korea, the Philippines and Indonesia for the period 1990-2001. Net private capital flows into six developing regions in the world totalled US$167.976 millions in 2001. Source: *2003 World Development Indicators*, database, World Bank, 13 April 2003.
[12] Studies on capital flows that affect output, exchange rates and balance of payments include Kim (2000), and Calvo and Reinhart (1999).
[13] Studies include Burnside, Eichenbaum and Rebelo (2003), Caporale, Cipollini and Demetriades (2003), and others.
[14] Korea's usable reserve fell from US$28 billion to a mere US$6 billion when their currency went on a free fall in December 1997: Aizerman and Marion (2002). Brazil's reserves fell from US$75 billion to less than half of that before the currency collapsed in 1998: Dornbusch and Fisher (2003).
[15] Karras and Song (1996) investigated 24 OECD countries for thirty years and found positive relationship between output volatility, economy's trade openness and exchange rate flexibility.
[16] Frommel, MacDonald and Menkhoff (2005), and Bailey, Millard and Wells (2001) found evidence of a relationship between productivity, growth and exchange rates.

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