Determinants of Real Effective Exchange Rate: Evidence from Panel Unit-Root and Co-Integration Approach

Haleema Sadia [*]
Eatzaz Ahmad [**]
Hajra Ihsan [***]

Abstract

This paper examines the determinants of real effective exchange rate (REER) for a panel of 13 countries covering post Bretton Woods period. The fundamental determinants of the equilibrium real exchange rate are terms of trade, trade openness, government expenditure, technology and capital controls. Im, Pesaran, and Shin (1997) unit root test confirms the non-stationarity of all the series. Pedroni (1997) co-integration test confirms stable long run relationship between REER and real variables. REER appreciates in response to changes in terms of trade, productivity and capital flows, and depreciates in the presence of open trade regime. Our results are robust to different measures of REER and trade openness.

Keywords: Real Effective Exchange Rate; Trade Openness; Co-integration; Pooled Least-Square

I. Introduction

Exchange rate determination is a central element in macroeconomic policy framework. Despite the voluminous literature

[*]Haleema Saadia is a Lecturer at International Islamic University, Islamabad; haleema.sadia@iiu.edu.pk
[**]Eatzaz Ahmad is a Professor at Quaid-e-Azam University, Islamabad
[***]Hajra Ihsan is an Assistant Professor at International Islamic University, Islamabad, Pakistan.

on exchange rate, there is no consensus on what actually determines real effective exchange rate (REER). Literature on *Open Economy Macroeconomics* highlights the importance of real factors for explaining exchange rate behavior that leads to dominance of real economy in the policy debate [see, for example, Drine and Rault (2003b) and Calderon (2004)]. Nevertheless, the notable problems related to time series data are lack of longer time series and low power of time-series unit root tests especially when samples are small. Thus this present study aims to reinvestigate empirically the long-run determinants of REER by applying novel non-stationary panel data techniques.

The present study is different from the available literature in a number of ways; *Firstly*, panel data techniques enable us to deal with non-stationary data for a heterogeneous pool of 13 selected countries over the period 1973-2006. To the best of our knowledge, slight attention has been paid in empirical studies to the use of these new methods to investigate the main macroeconomic variables influencing REER in the long-run.[1] *Secondly*, most of the previous studies have used bilateral exchange rates despite the common perception that bilateral real exchange rates may not necessarily represent the trade flows for some countries. Studies using bilateral exchange rate are based on bilateral US dollar exchange rate, while this benchmark becomes completely irrelevant if US is not a dominant partner for the other countries in the analysis. To cater to this problem, we choose a more comprehensive trade-weighted REER.

The paper is structured as follows. Section 2 reviews literature on exchange rate determinants. In Section 3 we present the methodology of our study. Section 4 discusses major issues concerning

[1] These techniques are more powerful than the conventional tests for time series as they rescue a few theoretical predictions that are not empirically validated by time series techniques [see Drine and Rault (2005a)]. The other advantages of panel data are discussed in detail by (Banerjee, 1999).

data and construction of variables. Estimation method and interpretations of results are reported in Section 5. The main findings are highlighted in the final Section.

2. Literature Review

In the last decade or so real exchange rate determinants have been subject to numerous theoretical and empirical work. Using pooled data for 12 developing economies, Edwards (1989) found that in the short-run real exchange rate movements respond to nominal as well as real shocks hitting those countries. However, the equilibrium level of real exchange rate is effected by only the real variables. Zhou (1995), Chen and Wu (1997) also found similar results based on quarterly data for European, and Pacific Basin countries respectively. Alexius (2000) attributed changes in real exchange rate to the supply shocks in the long run. The long run trajectory of real exchange rate is examined by Faruqee (1995). The study supported the role of structural components of current and capital accounts for determining the real exchange rate in the long-run. Bergvall (2002) found that both demand and supply side factors are important in the exchange rate movement for four Nordic Countries.

Studies using panel data techniques are scant. Chinn (1997) investigated determinants of real exchange rate (RER) for 14 OECD countries. Quere *et al.,* (2001) concluded that internal and external disturbances jointly determine the real exchange rate for the G-20 countries. Calderon (2002) confirmed co-integrating relationship between RER and terms of trade, net foreign assets as a ratio of GDP, productivity of traded goods relative to non-traded goods. For a sample of 16 Middle-East and North American and 45 developing countries respectively, Drine and Rault (2003a, 2005b) found that exchange rate is not simply explained by purchasing power parity (PPP) and economic conditions but factors such as level of development and conduct of economic policy are also important

considering the RER determination. Drine and Rault (2003b, 2005a) found that new panel data methodologies lead to acceptance of Balassa Samuelson (BS) Hypothesis. Similar conclusion was drawn by Choudhri and Khan (2005).

3. Methodology

From the voluminous theoretical literature on the determinants of REER, we chose Edwards' (1988) model as it is comprehensive, widely acceptable and hence the most intensively used analytical framework among the models of exchange rate determination. Following Edward's pioneering work, the number of applied studies on the estimation of equilibrium REER increased over the past few years both for developed and developing countries but still there is little consensus on what determines the long run equilibrium REER.

External terms of trade is the most significant variable and is fundamental to REER. However, terms of trade effect is theoretically ambiguous and hence a priori indefinite, contingent upon income and substitution effects and also on size of demand elasticities for exports and imports. In empirical literature income effect is found to have overweighed the substitution effect and hence REER appreciates in response to terms of trade improvement [Edwards (1988); Afridi and Siddique (1994)]. Similarly large elasticities of demand for exports and imports lead to REER appreciation.

The impact of government expenditure on REER depends on its level and distribution between traded and non-traded goods (Edwards, 1988). However, the effect of a rise in government spending on REER is a priori indefinite. In the most plausible case substitution effect overweigh the income effect inducing a rise in public spending and hence REER appreciation.

A positive productivity shock in the non-tradable sector induces income effect that result in an increase in demand for non-tradable goods and therefore its prices, leading to REER appreciation. Technical progress then shifts resources from the tradable to non-tradable sector. Price decreases in the non-tradable sector and REER depreciates. This is known as *offer effect*.

An increase in the degree of openness via decrease in import tariff raises demand for imports and hence the volume of trade. On the other hand, a fall in demand for non-tradables exerts a downward pressure on their prices. Since price of tradables is exogenous, relative price of tradable goods increase, that is, REER depreciates.

An increase in capital flows raises the demand and price of the non-tradable goods in the recipient country, hence REER appreciates. Capital inflows also increase domestic spending thereby reallocating resources from tradable to non-tradable sector. This reallocation increases the long-run demand and price of non-tradable sector thus appreciating REER.

Finally, terms of trade, government expenditure, productivity, trade openness and capital controls are primary determinants of the equilibrium real exchange rate. The relationship between equilibrium REER and the fundamentals is expressed as a vector of variables:

$$q_t = f(tot_t, g_t, gdp_t, to_t, capf_t)$$

where q_t = Logarithm of REER in period t

tot_t = Logarithm of internal terms of trade in period t

g_t = Logarithm of public spending as % of GDP in period t

gdp_t = Logarithm of GDP in period t

to_t = Logarithm of trade openness in period t

$capf_t$ = Logarithm of capital flows in period t

By considering CPI-based (external) REER, system equations for the real exchange rate fundamentals can be represented as:

$$q_t^1 = \beta_0 + \beta_{1i} tot_t + \beta_{2i} g_t + \beta_{3i} gdp_t + \beta_{4i} to_t + \beta_{5i} capf_t + \varepsilon_{it} \quad \textbf{(1)}$$

where q_t^1 = Logarithm of external REER in period t

Remaining definitions are the same as described above.

By considering WPI-based (internal) REER, system equations for the real exchange rate fundamentals can be represented as:

$$q_t^2 = \beta_0 + \beta_{1i} tot_t + \beta_{2i} g_t + \beta_{3i} gdp_t + \beta_{4i} to_t + \beta_{5i} capf_t + \varepsilon_{it} \quad \textbf{(2)}$$

where q_t^2 = Logarithm of internal REER in period t

Remaining definitions remain the same as described above.

We conducted a panel-data study for utilizing the novel panel unit root and co-integration tests. Im, Pesaran and Shin (IPS) Test is applied. IPS (1997) proposes an alternative procedure based on unit root test that is based on averaging the individual unit root test values.[2]

We shall apply Pedroni (1997, 1999) test for analyzing whether there exists any long-run relationship between REER and its determinants. Pedroni (1995, 1997) presented a test for null of no co-integration for simple bi-variate regression as critical values for more complex multivariate regression were not yet developed. Pedroni (1999) filled the gap by describing a method for multiple regressors and provided critical values of these tests. Null hypothesis of Pedroni (1999) is no co-integration. Specifically, Pedroni (1997) develops the asymptotic distributions for seven different statistics for exploring the small sample performances. Four statistics are based on pooling within-dimension, and three are based on pooling between-dimension.

[2] Detailed structure of IPS statistic is discussed by Im, Pesaran, and Shin. (1997,2003)

Within-dimension based statistics are known as panel co-integration statistics, and the between-dimension based statistics are group mean panel co-integration statistics. Lag-length for the band-width of the kernel estimator is selected following Newey and West (1994).

To test null hypothesis of no co-integration, we will compute the values of all seven statistics and compare with the appropriate tail of normal distribution.[3] For testing panel unit root and co-integration and estimating the co-integrating relationship (if exists) between real exchange rate and its primary determinants, unbalanced sample of 13 countries is considered over the period 1973-2006 for each cross-section, yielding a total of 442 time series pooled observations. Pooled Least-Square technique is employed for estimating co-integrating relationship.

4. Data and Construction of Variables

A sample of 13 countries is considered and divided into three groups: 5 developing (India, Korea, Pakistan, Philippine, Sri Lanka); 5 non-European developed countries (Australia, Canada, Japan, New Zealand, United States), and 3 European developed countries (France, Spain, United Kingdom). Annual data are collected on real exchange rates and its primary fundamentals (real output, money, terms of trade and government spending). The starting sample year varies for each country, depending upon when the Bretton Woods system became operational in different countries of the sample.

Data on nominal exchange rate, producer price index, consumer price index, and money supply are taken from different issues of *International Financial Statistics* (*IFS* hereafter). National sources are used whenever IFS does not provide data coverage. Data on primary determinants of real exchange rate (real GDP as proxy for

[3] For Details of Pedroni Co-Integration Test Stats see Pedroni (1995,1997,1999)

productivity, terms of trade index, government expenditure as percentage of GDP) are extracted from *World Development Indicators* (*WDI* 2007) published by World Bank. Data on factor productivity of the tradable and non-tradable sectors is not available. For that we followed Alexius and Nilsson (2000) and used real GDP as a proxy for the productivity of the non-tradable sector.

Financial and trade openness are measured by using outcome and policy measures. Outcome measure of trade is a ratio of the sum of real exports and imports to nominal GDP. Policy measure of trade openness is an updated version of the Sachs and Warner (1995) dummy variable of trade liberalization provided by Wacziarg and Welch (2003). Outcome measure of financial openness is the sum of portfolio equity stocks and foreign direct investment liabilities as the ratio of nominal GDP. Figures from Lane and Milesi-Ferreti (2001) are updated from IMF's *Balance of Payments Statistics*. Policy measure of financial openness is based on the *IMF* dummy variable of capital account restrictions.[4]

The choice of definition, methodology, weights, and indices used in the computation of REER was heavily influenced by data availability and the objective of this study. The multilateral or REER index is used here by considering the major trading partners only. The trading partner's weights are defined in such a way that weights sum to unity, i.e., $\sum_{j=1}^{k} wij = 1$. Trade weights are calculated as follow:

$$w_{ij} = \frac{(X_{ij} + M_{ij})}{\sum_{j=1}^{k} (X_{ij} + M_{ij})},$$

[4] Data on capital account restrictions is available at http://www.nber.org/~wei/data.html.

where w_{ij} = Trade share (weight) of country i with its partner j

M_{ij} = Imports of country i with j

X_{ij} = Exports of country i with j

k = Number of trading partners of the home country i

The weights rely on the average geographic distribution of imports and exports of goods and services for the sample period. Trade weights provide a more general view of the evolution of degree of competitiveness of a country compared to import or export weights. Hence, we used trade weights in our analysis that are constructed using data from different issues of *IMF* publication *Direction of Trade*.

We encounter several measurement problems regarding real exchange rate particularly the usage of different price and cost indices in computing the real exchange rate. For variety we calculated external (PPP-based) as well as internal trade weighted REER. As the prices of the non-traded and traded goods are not published as such, most research in this area proxy these by the consumer and producer price indices. External or PPP-based REER use the domestic and foreign country's consumer price index (CPI) that is a comprehensive measure of changes in competitiveness. Internal REER based on partner country's Wholesale Price Index (WPI) measuring traded goods prices and domestic CPI as an indicator of prices of non-traded goods are used.

For selection of major trading partners a fair representation is taken, that is, to cover all trading blocks by considering the major partners via trade volume. Nevertheless, availability of data on exchange rates and the price indices pose serious problems. Hence major trading partners are chosen by considering at least 20 major partners for each country that cover on average 77% of trade for the

selected countries. However, there are few exceptions.[5] Common base year of 2000 is considered for all computations and cross country comparisons. For capturing country-specific and time-specific effects on the static behavior of REER, we constructed 12 cross-section dummies by taking United States as the base category and 31 time dummies by considering 1973 as the base category. Table 1 summarizes the sample span, number of trading partners and trade covered for each selected country.

5. Results and Interpretations

We applied IPS test and Pedroni test for stationarity and the long-run relationship respectively. Method of Pooled Least-Square is applied for estimating co-integrating relationship between REER and its determinants (as specified in equation 1 and 2). Main results for the analysis of long-run primary factors affecting real exchange rate are summarized as below:

Results of IPS Test on series in level and first differences are reported in Table 2. Null hypothesis states that all series are stationary against the alternative that at least one series is non-stationary. Results confirm the hypothesis of non-stationarity for all the series in first difference. Therefore, we can conclude that the real exchange rate and all its primary determinants (expressed in level form) are integrated of order 1. After confirming non-stationarity of all the data series, we tested the possibility of long run relationship between exchange rate and its determinants.

[5] Canada is the exception with respect to the number of trading partners. Only one partner - United States - weighs more than 80% in Canada's trade. For India even after consideration of 27 partners the volume of trade covered is on average 62.6%. The reason behind lowest average share of India is that most Soviet block, especially former USSR weight heavily in the Indian trade, while the data on price indices and exchange rate for these countries are not available in *IFS*.

Table 3 present the results of pooled co-integration tests. The null of no co-integration is rejected for six out of seven test statistics. First statistic, panel variance statistics has a large positive value (diverges to positive infinity) that shows rejection of null hypothesis using right tail of the normal distribution. Out of the remaining six statistics, all except parametric group t-statistic diverge to negative infinity indicating rejection of null hypothesis using left tail of the normal distribution.

For both parametric and non-parametric group t-statistics, mean and variance adjustment terms are the same; however both give contradictory results about co-integrating relationship. That might be accorded to the different autoregressive processes used in computation of the two tests. The non-parametric group t-statistic is based on the first order autoregressive process, AR (1) while parametric group t-statistics is based on the ADF process. On the basis of unit root and co-integration tests for panel data, we can fairly conclude in favor of the long-run association between the REER and its fundamentals (external terms of trade, government consumption expenditures as % of GDP, productivity in non-traded sector proxied as real GDP, trade openness, and financial openness) for our sets of countries. This supports the popular view that, in the long-run, real exchange rate is determined by real or structural factors only.

The results about REER determinants are reported in Table 4. The upper section of the table report results for external REER (Equation 1). Initially we estimated the internal and external REER equations by including time and cross-section dummies. Wald test for joint restrictions lead to acceptance of null hypothesis, i.e., time and cross-section dummies are insignificant in our analysis. Hence we dropped these dummies and estimated the REER by Pooled Least-Square method. For the full sample all of the coefficients have expected signs and most of them are statistically significant.

Our findings confirm the previous empirical literature that real exchange rate is determined by the real and structural factors in the long-run. For full sample, 1% improvement in terms of trade appreciates equilibrium external exchange rate by 1.03%. For the sub-samples, a 1% improvement in TOT induces 2.57, 1.93, and 0.72% appreciation of REER for Non-European developed countries, European and Developing countries respectively. All the coefficients are statistically significant at 1% level. Our findings are in line with most plausible empirical evidence that wealth effect usually dominates the substitution effect and hence a TOT improvement is associated with REER appreciation [Edwards (1989); Drine and Rault (2005b)].

Also our findings support the viewpoint that when traded and non-traded goods are substitutes, any improvement in TOT appreciates the REER. For the full sample 1% increase in government expenditure depreciates the REER by 0.102%. For sub samples a 1% increase in public spending entails a REER appreciation of 2.58% for Non European developed countries, and a REER depreciation of 1.06% and 0.97% for Developing and European developed countries . The results for Non European developed countries are consistent with theoretical and most plausible empirical evidence that the substitution effect overweigh the income effect and hence a positive fiscal change will appreciate the REER.

However, the results for Developing and European developed countries reflect a strong *eviction effect*, i.e., if government spending are extensive in tradable goods, an expansionary budget policy results in tax increase and reduction in private demand for non-tradable goods. This decrease in demand, decrease prices of non-tradables and hence external REER depreciates. The coefficient of GDP (measuring Balassa Samuelson effect) is positive and statistically significant for the full sample as well as for sub-sample of countries. 1% increase in productivity leads to an appreciation of REER by 0.198% for the full sample, and 0.59%, 0.57%, and 0.18% for Developing, European and

Non European developed countries respectively. These results imply that growth in productivity is accompanied by a REER appreciation. The effect of economic growth on the evolution of REER is relatively lower in Non European developed countries and relatively higher for the Developing countries. This might indicate that countries with initially high level of growth grow at a slower rate than the countries with a relatively low initial level of economic growth.

The coefficient of trade liberalization is negative and statistically significant at 1% for the full sample as well for sub-sample of countries. Trade liberalization of 1% is accompanied by an equilibrium external REER deprecation of 0.148% for the full sample and 1.65%, 0.12%, and 0.09% for Developing, European and Non European developed countries respectively. These findings are consistent with theoretical and empirical evidence of Edwards (1989). The coefficient of capital flows confirm the theoretical predictions. A 1% increase in capital flows is associated with a real appreciation of 0.94% for the full sample.

For sub samples the corresponding appreciation is 0.54% for Developing countries, 1.30% for Non European developed countries and 0.68% for European developed countries. The positive coefficient confirms that capital inflows reallocate resources towards non-traded goods. This reallocation increases long-run demand price of non-traded goods and appreciation of external REER. R^2 is 0.27 for the full sample and 0.55, 0.56 and 0.67 for Developing, Non European and European developed countries. Since it is a cross-sectional analysis, these R^2 values suggest that the explanatory power of our full sample and sub-samples is quite reasonable.

Lower part of the Table 4 reports the estimation of results of the determinants of equilibrium internal REER. These results are in line with the results for external REER. Hence we can fairly conclude

that estimation results of equilibrium REER are robust to different measures of REER and openness.

5. Conclusion

Evidence from Im, Pesaran and Shin (1997) test confirms the non-stationarity of all the series. Results of co-integration test indicate the existence of a stable long run relationship between REER and real variables. REER appreciates in response to changes in terms of trade, productivity and capital flows. For the government consumption spending results are mixed. Trade openness unequivocally depreciates the REER. All the response parameters are significant except that of capital flows. The external shocks (terms of trade and trade openness) are most important determinants of both external and internal exchange rate for Developed countries. Supply shocks (productivity changes) are most important for European countries. For Developing countries commercial policy is most significant fundamental in the determination of both external and internal REER.

References

Alexius, Annika. (2000). Supply Shocks and Real Exchange Rates. *Sveriges Riksbank (Central Bank of Sweden) Working Paper* Number 117.

Alexius, Annika. and Nilsson, Jonny. (2000). Real exchange rates and fundamentals: Evidence from 15 OECD countries. *Open Economies Review* 11, 383-397.

Afridi, Usman. A., and Siddiqui, Rehana, (1994). Framework for Deriving Real Exchange Rates. *Pakistan Development Review*, Vol. 33 pp. 1099–1112.

Banerjee, A. (1999). Panel Data Unit Root and Co-integration: An Overview. *Oxford Bulletin of Economics and Statistics*, 61: 607-629.

Bergvall, Anders. (2002). What Determines the Real Exchange Rates? The Nordic Countries. *Department of Economics,* Uppsala University Sweden.

Calderon, Cesar. A. (April 2002). Real Exchange Rates in the Long and Short Run: A Panel Co-Integration Approach. *Bank of Chile Working Paper,* No. 153.

Calderon, Cesar.A. (2004). Real Exchange Rates in the Long and Short Run: A Panel Co-Integration Approach. *ILADES-Georgetown Revista de Análisis Económico,* forthcoming.

Chinn, Menzie David. (1997). Sectoral Productivity, Government Spending and Real Exchange Rates: Empirical Evidence for OECD Countries. *NBER Working Paper,* No. 6017.

Chen, Show-Lin and Wu, Jyh-Lin. (1997). Sources of Real Exchange Rate Fluctuations: Empirical Evidence from Four Pacific Basin Countries. *Southern Economic Journal,* Vol. 63, No.3, pp 776-787.

Choudhri, Ehsan U. and Khan, Mohsin S. (2005). Real Exchange Rates in Developing Countries: Are Balassa-Samuelson Effects Present? *IMF Staff Papers,* Vol. 52(3):387-409.

Drine, Imed and Rault, Christophe. (2003a). On the Long-Run Determinants of Real Exchange Rates for Developing Countries: Evidence from Africa, Latin America and Asia. *William Davidson Working Paper,* Number 571.

Drine, Imed and Rault, Christophe. (2003b). Long-run Determinants of Real Exchange Rate: New Evidence Based on Panel Data Unit Root and Co-Integration Tests for MENA Countries. *International Advances in Economic Research Issue,* February 2003.

Drine, Imed and Rault, Christophe. (2005a). Can the Balassa-Samuelson theory explain long-run real exchange rate movements in OECD countries? *Applied Financial Economics*, Vol 15, Issue 8: pp 519-530.

Drine, Imed and Rault, Christophe. (2005b). Learning about the Long-Run Determinants of Real Exchange Rates for Developing Countries: A Panel Data Investigation. *www.test.aup.edu/lacea2005/system/step2_php/papers/rault_chrau.pdf*, Sorbonne University, Paris.

Edwards, Sabastian. (1988). Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Countries. *NBER Working Paper*, Number 2721.

Edwards, Sabastian. (1989). Temporary Terms-of-Trade Disturbances, the Real Exchange Rate and the Current Account, *Economica*, Vol. 56(223): 343-357.

Faruqee, Hamid. (1995). Long-Run Determinants of the Real Exchange Rate: A Stock-Flow Perspective. *IMF Staff Papers*, Vol. 42(1): 80-107.

Im, K.S., Pesaran, M.H. and Shin, Y. (1997). Testing for Unit Roots in Heterogeneous Panels. *Mimeo, Department of Applied Economics,* University of Cambridge.

Im, K.S., Pesaran, M.H., and Shin, Y. (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics,* 115, 53-74.

Direction of Trade Statistics (1975-2006). International Monetary Fund (Washington D.C).

International Financial Statistics(1975-2006). International Monetary Fund (Washington D.C).

Lane, Philip R. and Milesi-Ferretti, Gian Maria. (2001). External Wealth, the Trade Balance, and the Real Exchange Rate. *CEG Working Papers, 2001, 13 Trinity College Dublin, Department of Economics.*

Newey, Whitney K and West, Kenneth D. (1994). Automatic Lag Selection in Covariance Matrix Estimation. *Review of Economic Studies,* 61, 631–653.

Pedroni, Peter. (1995). Panel Co-integration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an application to the PPP Hypothesis. *Manuscript, Department of Economics, Indiana University.*

Pedroni, Peter. (1997). Panel Co-Integration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Working Paper, Department of Economics, Indiana University.*

Pedroni, Peter (1999). Critical Values for Co-integration Tests in Heterogeneous Panels with Multiple Regressor. *Oxford Bulletin of Economics and Statistics,* 61, 653-678.

Quere, Agnes Benassy, et al. (2001). Real Equilibrium Exchange Rates: A G20 Panel Co-integration Approach. *http://thema.u-paris10.fr/papers/2005-03 Mignon.pdf.*

Sachs, Jeffrey.D and Warner, Andrew.M. (1995). Economic Reform and the Process of Global Integration. *Brookings Papers on Economic Activity* 1, 1-118.

Wacziarg, Romain and Welch, Karen Horn. (2003). Trade Liberalization and Growth: New Evidence, *NBER Working Paper* No. 10152.

World Bank, (2007). *World Development Indicators* CD-ROM. Washington, DC: The World Bank.

Zhou, Su (1995). The Response of Real Exchange Rates to Various Economic Shocks. *Southern Economic Journal,* Vol. 61(4): 936-954.

Appendix: Text Tables

Table 1: Sample Span, Trading Partners and Trade Shares for the Selected Countries

Country	No. of Observations (Period)	No of Trading Partners	Average Share of Trading Partners	Maximum Share of Trading Partners	Minimum Share of Trading Partners
Australia	23 (1984-2006)	23	75.74	81.50	70.15
Canada	34 (1973-2006)	12	86.00	90.10	80.10
France	34 (1973-2006)	30	76.70	81.90	67.75
India	27 (1980-2006)	27	62.60	77.80	57.90
Japan	31 (1976-2006)	31	73.14	78.10	63.50
Korea	34 (1973-2006)	31	78.40	89.30	69.00
New Zealand	31 (1976-2006)	20	81.10	83.34	77.73
Pakistan	24 (1983-2006)	30	73.70	77.70	69.60
Philippines	34 (1973-2006)	20	80.0	90.00	74.82
Spain	31 (1976-2006)	28	76.60	83.67	64.41
Sri Lanka	31 (1976-2006)	26	78.55	83.00	73.67
United Kingdom	34 (1973-2006)	32	78.80	84.66	69.93
United States	34 (1973-2006)	35	80.00	85.10	72.02
Average	30.92	26.54	77	83.63	70.04

Table 2 Im, Pesaran and Shin (1997, 2003) Pooled Unit Root Tests Results

H_0: All series are stationary; H_1: At least one series is non-stationary (Unit root hypothesis)

Non European Developed Countries

	Level		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
q1	-1.21	-1.60	-2.05	-2.40
M	0.85	1.16	-4.37	-5.79
Tot	-1.20	-0.95	-7.83	-6.10
G	-0.46	0.45	-8.96	-9.25
Gdp	-0.61	0.18	-4.48	-6.86
Gdppc	-1.22	-0.35	-3.21	-4.60
To	-1.06	-0.70	-7.43	-7.25
Fo	-1.45	-0.82	-2.89	-3.43

Developing Countries

	Level		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
q1	-1.21	-1.60	-2.05	-2.40
M	0.72	1.05	-7.52	-9.12
Tot	-0.20	-0.95	-4.83	-4.10
G	-0.46	1.45	-5.96	-6.25
Gdp	-0.75	1.18	-4.48	-5.86
Gdppc	-0.42	-1.27	-6.21	-7.60
To	-1.06	-0.70	-5.28	-5.97
Fo	-0.37	-0.93	-2.35	-3.81

European Developed Countries				
	Level		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
q1	-0.35	-1.26	-3.28	-4.81
M	0.91	1.21	-5.29	-6.66
Tot	-0.65	-1.20	-3.28	-4.91
G	-0.68	0.67	-4.34	-6.26
Gdp	-0.91	1.23	-4.16	-3.97
Gdppc	-0.83	-1.61	-4.93	-6.60
To	-0.58	-0.87	-3.18	-5.25
Fo	-0.64	-1.24	-2.84	-4.55

As this is one sided test, the critical value is -1.65 (at 5 % level) and for unit root to exist calculated statistics should be larger than 1.65 in absolute terms.

Table 3 Pedroni (1995, 1997, 1999) Panel Co-Integration Test

Panel Co-Integration Tests

Panel v-Statistic (Non-Parametric)	Panel *rho*-Statistic (Non-Parametric)	Panel *t*-Statistic (Non-Parametric)	Panel *t*-Statistic (Parametric)
978.017*	-315450612.8*	-2.0111*	-10.507*

Group Mean Co-Integration Tests

Group *rho*-Statistic (Non-Parametric)	Group *t*-Statistic (Non-Parametric)	Group *t*-Statistic (Parametric)
23554.015*	-718.7667*	3.640641**

Table 4 Parametric Estimates of Equilibrium REER Equations

Parametric Estimates of Equilibrium External REER Equation (Eq. 1)				
Dependent Variables External REER (q_t^1)	Full Sample	Developing Countries	Non European Developed Countries	European Developed Countries
Constant	5.58 (0.00)*	12.78 (0.00)*	-15.33 (0.00)*	-6.1 (0.013)*
$Log(tot_t)$	1.030 (0.00)*	0.724 (0.010)*	2.57 (0.00)*	1.93 (0.00)*
$Log(g_t)$	-0.102 (0.70)	-1.06 (0.02)*	2.58 (0.00)*	-0.97 (0.00)*
$Log(gdp_t)$	0.198 (0.00)*	0.594 (0.00)*	0.186 (0.00)*	0.57 (0.00)*
$Log(to_t)$	-0.148 (0.00)*	-1.656 (0.00)*	-0.095 (0.04)*	-0.123 (0.08)***
$Log(fo_t)$	0.940 (0.91)	0.541 (0.00)*	1.301 (0.00)*	0.68 (0.00)*
Observations	383	139	151	93
R^2	0.270	0.550	0.560	0.670

Parametric Estimates of Equilibrium Internal REER Equation (Eq 2)				
Dependent Variables External REER (q_t^2)	Full sample	Developing Countries	Non European Developed Countries	European Developed Countries
Constant	6.630 (0.00)*	14.30 (0.00)*	-13.23 (0.00)*	-10.77 (0.00)*
$Log(tot_t)$	0.950 (0.00)*	0.690 (0.02)*	2.560 (0.00)*	1.900 (0.00)*
$Log(g_t)$	-0.110 (0.49)	-1.160 (0.01)*	2.530 (0.00)*	-0.790 (0.00)*

$Log(gdp_t)$	0.249 (0.00)*	0.675 (0.00)*	0.220 (0.00)*	0.960 (0.00)*
$Log(to_t)$	-0.288 (0.00)*	-1.880 (0.00)*	-0.060 (0.58)	-0.375 (0.08)***
$Log(fo_t)$	0.280 (0.50)	0.630 (0.00)*	1.180 (0.00)*	1.370 (0.00)*
Observations	383	139	151	93
R^2	0.274	0.570	0.537	0.651

Here tot, g, gdp, to, and fo represent external terms of trade index, government spending, GDP, trade openness and financial openness respectively.
* and *** denotes significance at 1%, and 10% respectively. Numbers in parenthesis are P-values.