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Determinants of International Reserves: Empirical Evidence from Emerging Asia

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Abstract

In this study, we attempt to estimate the long term determinants of international reserves in the emerging Asian for the period 1980-2011. In this study, we attempt to estimate the long term determinants of international reserves in the emerging Asia for the period 1980-2011. Utilizing a well-established panel data estimation technique fully modified OLS (FMOLS), we find that trade openness, country size, export volatility and opportunity cost of reserve accumulation are significant factors explaining the determinants of international reserves in the emerging Asia. Under the environment of high dependency on inelastic imports and capital mobility with frequent and costly financial crises, it seems that these countries self-insurance themselves against the possible currency crisis.

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1. Introduction

Accumulation of international reserves has increased many folds in the emerging Asian economies after the East Asian financial crisis. In fact, the reserves hoarding has outpaced all traditional benchmark levels (IMF, 2010). As of 2011, out of total 10.8 trillion USD reserves holding, developing countries hold around 7.1 trillion USD (excluding gold), in in which emerging Asia[1] contributes around 45% (IMF, 2012). Such large reserves accumulation has some serious implications for the balance sheet of the central bank, the banking system and the economy as a whole (e.g. see Banchs and Mollejas, 2010, Shrestha, 2013). Considering the large amount of international reserves held by these emerging Asian countries, it is quite interesting and relevant for a policy standpoint to investigate the determinants of international reserves which prompt these countries for a steady accumulation.

A strand of empirical research on the international reserves discussed about determinants of international reserves and successfully established a relatively stable long run demand for international reserves based on limited number of explanatory variables (Edwards 1985; Aizenman et al, 2003, 2007a, 2007b; Bahmani-Oskooee et al 2002, 2011; Gosselin, 2005, Sharma and Singh 2014). Based on the findings of these studies, the determinants of international reserves can be discussed in terms of economic size, trade openness, financial openness, exchange rate variability, export variability, monetary factors and opportunity cost of holding reserves. Against this background, this study is set to estimate the determinants of international reserves for the eight emerging Asian countries, namely China, India, Indonesia, South Korea, Malaysia, Philippines, Singapore and Thailand.

The remaining paper is organized as follows: Section 2 deals with data description and their measurement, Section 3 describes the empirical model, Section 4 talks about the estimation results and Section 5 concludes the study with some recommendations.

2. Data Description and Measurement

To conduct the empirical investigation, we have taken the data of the eight countries from the World Development Indicator (WDI, 2012). The analysis covers the period 1980-2011 and the year 1980 is considered as starting year as after the collapse of the Bretton-wood system, most of these economies have initiated serious economic reforms which include open trade and free capital flow policies[2]. Subsequently, these economies experience significant economic growth in

[1] Countries in consideration as emerging Asia are: China, India, Indonesia, South Korea, Malaysia, Philippines, Singapore and Thailand.

[2] Though the Bretton wood system ended in early 1970s, however, the data for our analysis purpose is available only from 1980 onwards for the sample countries.

the last three decades. We include countries for analysis on basis of size and importance[3]. Details of data series, their definitions and sources are presented in Table 1.

Table 1: Data Description

Variables	Definition & Measurements	Sources
Endogenous Variables		
International Reserves (*RES*)	Log of total international reserves minus gold (deflated)	WDI
GDP per capita ($PGDP$)	Log of GDP per capita (deflated)	WDI
Trade Openness ($topen$)	Total Export plus import divided by GDP	WDI
Financial Openness ($fopen$)	Total external assets plus liabilities divided by GDP	WDI[4]
Exogenous Variables		
Exchange Rate Volatility ($XVOL$)	Square of mean adjusted relative change in Official exchange rate (per US Dollar)	WDI and author's construction
Export Volatility ($EVOL$)	Square of mean adjusted relative change in export receipt	WDI and author's construction
Opportunity cost of holding international reserve (r^N)	Short term domestic deposit rates minus US 10 years T-bill rate	WDI & Federal reserve, USA
Monetary Disequilibrium ($MDISQ$)	Money Supply (t-1) minus money demand (t)	WDI and Authors' construction[5]

3. Empirical Model

To examine the determinant of international reserves in the emerging Asia during 1980-2011, our empirical model is as follows:

[3] We exclude some small emerging countries of region in our analysis mainly because of unavailability of the required data.

[4] This data series constructed using the dataset of Lane and Milesi-Ferretti (2007).

[5] Monetary disequilibrium is calculated based on the approach by Badinger (2004) and Mishra and Sharma (2011). The basic framework for calculating monetary disequilibrium are following:
$M_{2t} = \varphi_0 + \varphi_1 GDP_t + \varphi_2 R_t + \varepsilon_t$; where M_{2t} is real money supply, GDP_t is real gross domestic product, R_t is short term deposit rate and ε_t is stochastic error term. All variables except short term deposit rate are in log form. Using the long run relation for each cross section, we estimated the following model to compute monetary disequilibrium: $lnM_t^{dis} = lnM2_{t-1} - lnM2_t^*$; where $M2_t^*$ is the equilibrium value of money demand. The calculated positive (negative) values of M_t^{dis} indicates an excess supply (excess demand) for money.

$$RES_{it} = \beta_1 + \beta_2 fopen_{it} + \beta_3 topen_{it} + \beta_4 PGDP_{it} + \beta_5 EVOL_{it} + \beta_6 XVOL_{it} + \beta_7 MDISQ_{it} + \beta_8 r^N{}_{it} + \mu_{it} \quad (1)$$

$$i = 1,2,\dots,8 \;\&\; t = 1,2,\dots,32$$

where variables are as defined in Table 1. Our variables in consideration are subject to non-stationarity of the time series, which might lead to biased estimation of the coefficients. To test the non-stationarity problem, we used the Im-Pesaran-Shin (IPS) panel unit root test which is based on the simple averages of the individual cross sectional augmented Dicky-Fuller statistics (Im, et. al, 2003). The result of panel unit shows that the null hypothesis of unit root cannot be rejected at level form but can be rejected in the first difference form[6]. Since all our endogenous variables are found to be *I (1)*, we can employ the panel cointegration test. We test Pedroni's (1999), an extension of the Engle-Granger construction to test of the cointegration relationship. Results of the cointegration test are reported in Table 2, which clearly indicate that our endogenous variables form a long term relationship as out of seven cases, the null hypothesis of no co-integration is convincingly rejected in five cases.

Table 2: Pedroni's panel cointegration test results

Types	Statistics (Individual Intercept)	P-Value
Panel v-Statistic (within dimension)	1.684**	0.0461
Panel rho-Statistic	-1.175	0.1199
Panel PP-Statistic	-2.818**	0.0024
Panel ADF-Statistic	-3.370**	0.0004
Group rho-Statistic (between dimension)	0.383	0.6494
Group PP-Statistic	-2.022**	0.0215
Group ADF-Statistic	-2.932**	0.0017

Notes: ** indicates significant at 5 % level and lag selection is based on the SIC criterion.

4. Estimation Results and Discussions

After establishing a cointegrating relation between variables that keeps the pooled variables in proportion to one another in the long run, we now proceed to generate individual long-run estimates for our model. As the OLS estimator yields biased and inconsistent estimates when applied to cointegrated panels, we utilize the ''group-mean'' panel Fully Modified OLS (FMOLS) estimator proposed by Pedroni (1999, 2001). The FMOLS estimator not only provides consistent estimates coefficients in relatively small samples, but it also takes care the likely problems of endogeneity of the regressors and serial correlation. Results of the FMOLS estimates of the determinants of the international reserves are reported in Table 3, which include both endogenous as well exogenous variables.

[6]Our result shows that log of deflated international reserves, trade openness, financial openness and log of GDP per capita are stationary at first difference and export volatility, exchange rate volatility, monetary disequilibrium & interest rate differential are stationary at level form. These results are not reported here due to space constraint but the results can be made available on request.

The estimated results indicate that the determinants of international reserves are different for different sample countries. Export volatility, trade openness, GDP per capita and interest rate differential are the most significant factors explaining the determinant of international reserves as a whole. The impact of country size measured as GDP per capita is quite significant in explaining the determinant of international reserves which is quite intuitive. The result shows that 1 % increase in the GDP per capita will tend to increase the international reserve by almost 2.45% for the sample countries. Except for the Philippines where it is quite large (4.9%), findings are very similar in almost every country. Further, trade openness and export volatility are positively related to international reserves. The results imply that countries with high degree of openness and uncertainty in trade tend to have a large amount of international reserves which in turn indicates that countries accumulate reserves for the precautionary purpose. The Financial openness is estimated to be not a crucial factor for overall sample, yet important for some of countries of the region, i.e. the Philippines and S. Korea.

Focusing on the opportunity cost of holding reserves, results indicate that the central banks do consider this aspect in accumulating reserves. Our estimate shows that one unit increase in interest rate differential will tend to decrease the reserves by 0.02%. Hence, increase in the spread between short term deposit rates and US T-bill rate will tend to decrease the amount of international reserves held by developing economies.

Table 3: Determinants of International Reserves: FMOLS Results

Country	$EVOL$	$XVOL$	$fopen$	$topen$	$PGDP$	r^N	$MDISQ$
China	0.94 (0.28)	1.12 (0.6)	1.20 (1.24)	0.08 (0.12)	1.72** (4.17)	-0.07** (-2.7)	-1.18** (-2.17)
India	12.63 (1.14)	-5.07 (-0.43)	-0.6 (-0.25)	5.47 (1.52)	1.55 (1.24)	-0.002 (-0.05)	-0.54** (-1.96)
Indonesia	5.29** (3.31)	0.86 (1.55)	0.25 (0.66)	-0.29 (-0.35)	2.26** (8.11)	-0.07** (-2.72)	0.14 (0.83)
S. Korea	1.78 (0.24)	6.41* (1.8)	-0.90* (-1.68)	2.22* (1.72)	1.75** (4.04)	-0.13** (-3.15)	1.41** (3.58)
Malaysia	-2.13 (-0.35)	-2.9 (-0.96)	0.79** (2.51)	-0.16 (-0.38)	2.17** (2.83)	-0.02 (-0.77)	0.04 (0.33)
Philippines	0.1 (0.02)	-3.96 (-1.05)	2.19** (2.99)	2.83** (4.82)	4.90** (4.26)	0.06 (1.15)	-0.14 (-1.55)
Singapore	3.04* (1.86)	0.39 (0.09)	-0.06** (-5.14)	-0.08 (-1.16)	2.84** (18.08)	0.02 (1.62)	0.25** (2.18)
Thailand	2.21	-8.91	0.33	0.54	2.52**	0.1	-0.08

	(0.42)	(-1.56)	(0.71)	(0.53)	(3.36)	(1.46)	(-0.55)
Overall	2.98**	-1.51	0.41	1.33**	2.46**	-0.02*	-0.01
	(2.45)	(-0.01)	(0.37)	(2.41)	(16.3)	(-1.83)	(-0.25)

Notes: 1. ** & * indicates significant at 5% and 10 % level, respectively. 2. Export volatility, exchange rate volatility, interest rate differential and monetary disequilibrium as exogenous variable to see the long term impact on international reserves.

On the exchange rate volatility, our result shows that this is rather an insignificant factor; perhaps exchange rate volatility is a reflection of other macroeconomic factors which are already accommodated in our empirical model through other variables. Finally, the monetary disequilibrium, though insignificant overall, is significant for half of the sample countries explaining that excess demand (supply) for money results in an increase (decrease) in international reserves (excess demand of money for South Korea and Singapore and excess supply for India and China). The statistical coefficient of monetary disequilibrium indicates that the central banks of these countries take measures to clear the money market by making appropriate changes in both the interest rate and domestic credit (Badinger, 2004). This is an interesting finding and supporting the standard economic theory[7].

5. Conclusion and Recommendations

Results of our analysis show that trade openness, country size, export volatility and opportunity cost of reserve accumulation are significant factors explaining the determinants of international reserves in emerging Asia. Since these countries are heavily dependent of inelastic nature of imports and experience an environment of high capital mobility with frequent and costly payment imbalances, it seems that these countries self-insurance themselves against the possible currency crisis by accumulating a huge pile of international reserves.

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[7] The monetary theory postulates that a country's balance of payments disequilibrium is directly associated with a disequilibrium in its domestic money market. It means if there is an excess demand (or supply) of money, it must be satisfied by an increase (decrease) in international reserves holdings of a country's central bank (Bahmani-Oskooee and Brown, 2002).

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