

**DETERMINANTS OF FOREIGN EXCHANGE RESERVES HOLDINGS IN
EAST-ASIA, PACIFIC AND SOUTH ASIA**

By
BOU, Sovanpich

THESIS

Submitted to
KDI School of Public Policy and Management
In Partial Fulfillment of the Requirements
For the Degree of
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Committee in charge:

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ABSTRACT

DETERMINANTS OF FOREIGN EXCHANGE RESERVES HOLDINGS IN EAST- ASIA, PACIFIC AND SOUTH ASIA

By

Bou Sovanpich

The main purpose of this study is to find the significant determinants of foreign exchange reserves holdings in East-Asia, Pacific, and South Asia using Panel Fixed Effect model of 10 countries in lower middle income group in these regions.

Our study has found that the size of the economy, trade openness, financial openness and external debts increase reserves holdings while the economic wellbeing of the people and the appreciation of real effective exchange rate decrease the central banks' incentives to accumulate international reserves.

Keywords: foreign exchange reserves; determinants; East Asia; Pacific; South Asia; population; real GDP per capita; REER; net inflows; exports; imports; external debt

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I. INTRODUCTION

1.1. Background

Foreign exchange reserves (international reserves, or foreign reserves) comprise foreign currency reserves and non-currency reserves, which include monetary gold, Special Drawing Rights (SDR), reserve position at International Monetary Fund (IMF) and other reserve assets (Dominguez, Hashimoto, & Ito, 2012). The reserves are indispensable financial resources of a country, because they are used by the central banks to intervene in foreign exchange market, to deal with balance of payments, to strengthen financial stability and the country's credibility, and to accumulate the national treasure repository (National Bank of Cambodia, 2017). This means that for a country whose exchange rate is not entirely determined by the market, reserves are used to stabilize the exchange rate. Moreover, to cope with current account deficit, reserves are to offset the balances. Equally important, foreign reserves serve as a cushion against financial crisis when the countries experience the absence of capital flows. Again, the more reserves a country holds, the credible it is in the lenders' perspectives.

Therefore, ensuring the adequacy of foreign reserve holding is a crucial matter. The reserve adequacy is assessed by its capacity to function as precautionary and non-precautionary buffers (Tiwari, 2016). The precautionary buffer is for the reserves to combat external shocks, unexpected and unfavorable circumstances like the absence of capital flows, while the non-precautionary buffer is for the reserves to stabilize foreign exchange market and target an inflation (Tiwari, 2016).

As the first and foremost purposes of holding international reserves are to prevent a country from falling into crises, and sustain the economy once it does fall into chaos,

reserves have usually been scaled to 3 variables such as imports, short-term external debt and broad money (International Monetary Fund, 2004). To elaborate, these scaling methods show how foreign reserves can be used to cover current level of imports, to pay back the country's short-term debt, and to have foreign currencies in place for people who want to exchange their domestic currencies for the foreign ones. These three "rules of thumb" measure the adequacy of foreign reserves as follows: 1), import cover of at least 3 months, 2), the "Greenspan-Guidotti" rule of 100% cover of short-term debt, and 3), the ratio of reserves to broad money of 20% (Moore & Glean, 2016; IMF, 2015). This shows that if a country's reserves satisfy these conditions, its reserve level is adequate.

However, these approaches are limited as other important variables cannot be captured effectively along with economic expansion (IMF, 2015). That means each approach is applicable only with a particular characteristic of a country. For instance, import cover scaling method is only suitable with countries with less open capital account, but it is less useful for financially open countries. Similarly, the "Greenspan-Guidotti" rule of 100% cover of short-term debt is appropriate for countries with large short-term financial transactions. Likewise, the ratio of reserves to broad money is largely relevant for the countries with dominant banking sector and very open capital accounts, from which the ratio is used to capture capital flight risk (IMF, 2015).

1.2. Importance of the study

A study on the deciding factors of foreign reserves has been conducted to incorporate all important factors simultaneously namely, economic size, current and capital account vulnerabilities, exchange rate flexibility, and opportunity cost (International Monetary Fund, 2004). This means that population, real GDP per capita, trade openness, financial openness, and exchange rate regime affect reserve holding levels. To illustrate, the more population and their economic well-being, the more reserve holding is needed. Likewise, an open economy seen by its export and capital flow volatilities needs more reserves to function as a cushion against financial crisis. However, a country with flexible exchange rate demands few reserves as the central bank does not need the reserves to intervene in the foreign exchange market. The opposite is true in this context.

1.3. Objectives of the study

This study is to determine the important factors in determining the reserve holding levels for the countries in lower middle income group in East Asia, Pacific, and South Asia such as Bhutan, Cambodia, Indonesia, Lao PDR, Mongolia, Myanmar, Philippines, Sri Lanka, Timor-Leste and Vietnam from 1992 to 2017.

1.4. Research Questions and Hypotheses

The core question of the study is: “What are the determinants of reserves holdings in East Asia, Pacific and South Asia?” Taking economic size, current and capital account vulnerabilities, and exchange rate volatility into consideration, it is hypothesized that the region’s foreign reserves positively correlate to its economic size, current and capital account vulnerabilities, but negatively correlate to exchange rate volatility (International Monetary Fund, 2004).

II. LITERATURE REVIEW

2.1. Overview of foreign exchange reserves

According to the IMF's Balance of Payments Manual, reserve assets are external assets that are readily available and controlled by monetary authorities for meeting balance of payments financing needs, intervention in exchange markets, and other related purposes to improve confidence in the currency and the economy as well as the basis for foreign borrowing (International Monetary Fund, 2011).

Initially, reserve holding for precautionary purpose means that central banks must hold sufficient reserves to prevent external shocks from sudden stops in capital flows and flow reversals, proved by the reduced likelihood of crisis events and central banks' fear of capital mobility (Steiner, 2013; Moore & Glean, 2016). Moreover, reserve accumulation is an alternative to capital controls in addition to the fixed exchange rate regimes and independent monetary policies the central banks are pursuing. This suggests that reserves play an important role in allowing the central banks to manipulate Mundell-Fleming trilemma, which states that a country can only achieve two of the three economic policies among free flows of capital, fixed exchange rate regime, and independent monetary policy (Steiner, 2013).

Furthermore, reserves for transaction purpose are used to stabilize domestic exchange rate, thereby sustaining confidence in monetary and exchange rate policies (Panda & Trivedi, 2016; Steiner, 2013). Additionally, reserves are required to finance deficits in balance of payments under a fixed exchange rate system. At the same time, the reserve holding reduces external borrowing cost since it exhibits credibility to external

lenders and credit rating agencies on the country's capacity to pay back foreign debt. Equally important, reserve holding promotes public confidence on the monetary authorities because sufficient foreign assets are considered fundamentals of domestic currency (IMF, 2013).

First introduced by John Maynard Keynes, levels of foreign reserve holding were affected by international financial integration, external trades, and current account imbalances (In & Part, 2013). This indicates that the more a country opens to the outside world, the more reserves it needs for precaution to prevent external drain of foreign reserves or capital outflows.

The perspective was followed by the IMF's noticeable focus on international trades in 2001 to assess reserve adequacy by import coverage, which has since then been extensively used. As a rule of thumb, foreign reserves should not drop below a level of three months' worth of imports so as to safeguard against external drain of foreign reserves (In & Part, 2013).

Besides precautionary purpose, the reserve accumulation is for mercantilism in order to promote export competitiveness, especially in China (Aizenman & Lee, 2007). This means that China devalues its currency Chinese Yuan (CNY) by selling CNY and buying foreign currencies so that China's exports will appear cheaper than other countries, boosting China's exports.

Precautionary and transaction purposes of reserve accumulation have a common perception that an adequate level of reserve holding is the result of central banks' optimizing behavior (Steiner, 2013).

2.2. Who decide on foreign reserves?

Stakeholders who decide on the levels of international reserves are central bank and government in line with monetary policy, international agreement to maintain certain exchange rate stability, and policies reflected in large current account surplus (IMF, 2013). The decision of monetary authority is particularly based on the combination of balance of payments financing and adjustment in balance of payment deficit, and their preference between level and stability of national income (Bird & Rajan, 2003).

2.3. Reserve adequacy

The fall of the Bretton Woods system in the early 1970s led to the abandonment of USD-pegged exchange rate by most industrial countries. This shift to freely floating or managed currencies also led to capital account liberalization (In & Part, 2013) with the free flow of capital (Henry, 2007). Therefore, reserve adequacy became less important (In & Part, 2013).

Nevertheless, the experience in emerging economies, especially the 1980s debt crisis in Latin America due to external deficits and trade openness increased the importance of reserve accumulation and its adequacy (In & Part, 2013). Reserve adequacy depends on the combination of economic policies and performance as well as degree of political stability (Bird & Rajan, 2003).

On the other hand, reserve inadequacy could pose various challenges on different countries. Some countries choose to hold more reserves than others, leading to the uncertainty as to what level of reserves is adequate, inadequate, or excessive (Bird & Rajan, 2003). Currency crises during the 1990s and early 2000s in emerging economies

such as Mexico, Thailand, South Korea, Indonesia, Malaysia, Russia, Brazil and Argentina have increased the importance of reserve adequacy (Bird & Rajan, 2003).

2.3. Existing approaches and limitations

Reserves have been largely scaled to three measurements: first, months of imports to measure how long reserves can pay for the imports; second short-term external debt to show the likelihood and depth of financial crisis and capture external drain; and third broad money to capture internal drain, the probability that the residents are likely to convert domestic currency to foreign currencies (International Monetary Fund, 2004). The two latter scaling methods are used to assess reserve adequacy in financial crisis time (International Monetary Fund, 2004).

However, rules of thumb are limited in scope in that each just focuses on particular aspect of an economy. In this case, the import coverage of at least 3 months is not a strong approach because there should be no specific ratio that can prove the suitability of reserve levels with the growth of trade over time (Bird & Rajan, 2003). Again, the reserves-to-import ratio only reflects the vulnerability of a current account in balance of payments, but it does not show probability of a crisis (Bird & Rajan, 2003). Worse, there is no correlation among the three rules of thumb (Bird & Rajan, 2003).

2.4. Cost of holding reserves

During the first decade of 2000s, global international reserves grew to 11 trillion USD primarily because of increasing returns from investments in a high-yield environment (In & Part, 2013). Moreover, the increase was also due to precautionary purpose motivated by globalization and financial crises in various emerging economies in the 1990s and early 2000s namely, Mexico (1995), East Asia (1997), Russia (1998),

Turkey (1994 and 2001), Brazil (1999), and Argentina (2002) (In & Part, 2013). This means that the countries held a large amount of reserves to protect themselves from external shocks in crisis time. Unfortunately, as a result of Global Financial Crisis of 2007-08, the yield on global safe assets plummeted as the US effective fed fund rates were in the range of 0.16% to 0.24% between December 2008 to December 2015 (Federal Reserve Bank of St. Louis, 2018) while the foreign reserves were still increasing. This led to the measurement of reserve adequacy (In & Part, 2013) because opportunity cost was taken into account as the reserves could have been held in local currencies and invested in higher-yield assets (International Monetary Fund, 2004).

The cost of holding reserves is the growth forgone by holding reserves rather than investing in projects to boost long run economic growth, derived from a panel growth regression for a sample of small states. To clarify, once reserves exceed 25 weeks of imports, the magnitude of growth reduction outweighs the reduction of probability of a crisis (Moore & Glean, 2016).

Moreover, an opportunity cost of holding reserves is the difference between the return on reserves and the marginal productivity of an alternative investment (International Monetary Fund, 2004). Since the three hierarchical objectives of investing foreign reserves are: 1), capital preservation, 2), liquidity, and 3), income, reserves are invested in safe and low-yield foreign assets (National Bank of Cambodia, 2017). This would create an opportunity cost had the reserves been converted to local currencies and invested in higher-yield domestic investments, thus implying that the level of reserves and opportunity cost are negatively correlated.

Furthermore, domestic costs of holding foreign reserves is the difference between the interest paid on the country's public debt and the interest earned on reserves (International Monetary Fund, 2004; Bird & Rajan, 2003). To simplify, an increase in reserves equals an increase in public debt because the central banks inject domestic currencies to the public to buy foreign currencies. Also, the foreign currencies could have been used to pay foreign debt. In addition, rapid reserve accumulation reflects an undervalued exchange rate (International Monetary Fund, 2004) as the monetary authorities inject too much liquidity into the market.

2.5. Reserve accumulation in developing and emerging countries

Developing countries accumulate reserves to shield themselves against exogenous shocks (Aizenman & Lee, 2007), and to support their pegged exchange rates (Moore & Glean, 2016). Moreover, low-income countries with prolonged balance of payments problems and lack of international capital market access should have effective reserve management because their overall risks tend to be higher than those facing other countries (Bird & Rajan, 2003).

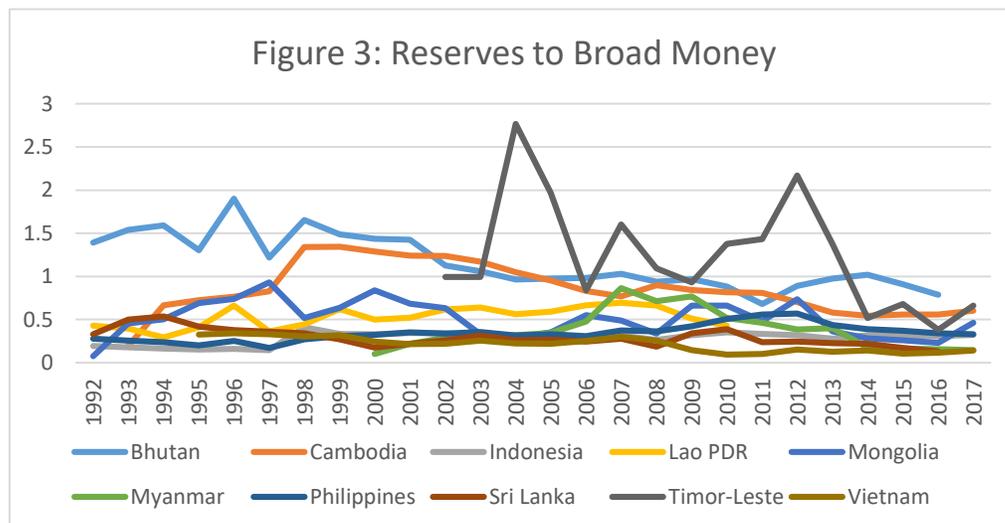
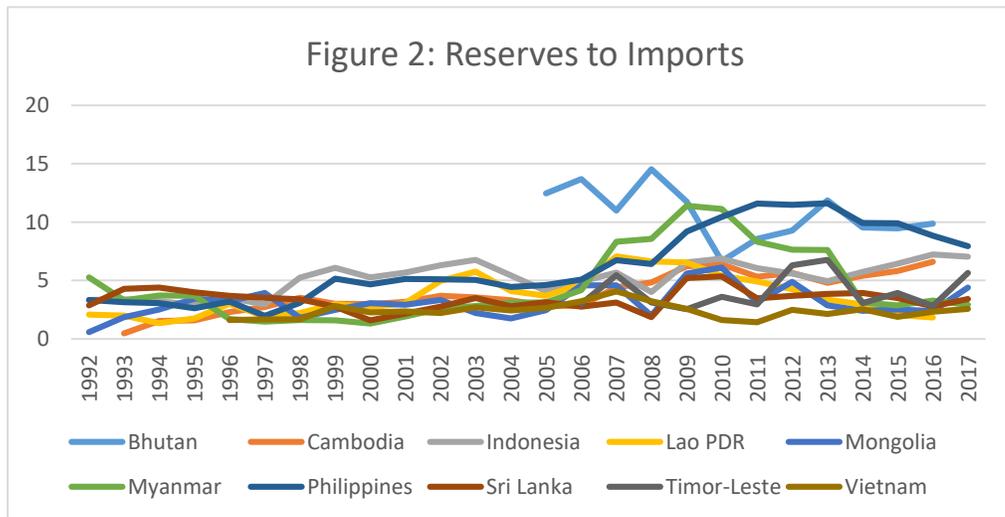
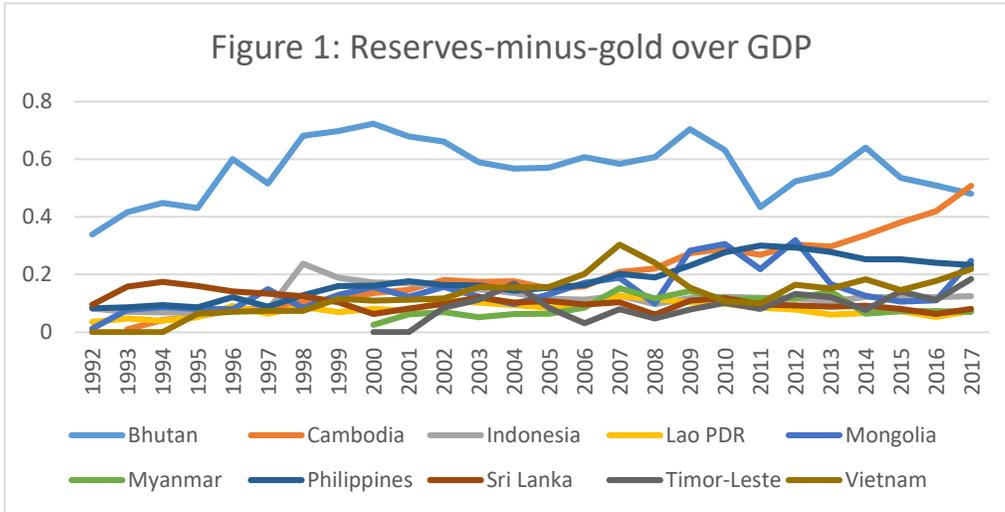
Reserves in 122 emerging markets from 1980 – 1996 have been scaled by imports, short-term external debt, and broad money. The approaches have found that the reserves in emerging countries have increased over the past decades (International Monetary Fund, 2004). The results of the correlation coefficients from the regression were applied to predict the reserve levels from 1997 – 2002 with actual reserve buildups reserves in the same period. The finding was that the reserves in many emerging countries have increased more quickly since 2001 than determined by fundamentals (International Monetary Fund, 2004).

Nitithanprapas and Willet's study (as cited in Bird & Rajan, 2003) measured the reserve levels of many emerging countries from 1996 – 2005 and found that Hong Kong, Indonesia and the Philippines have adequate reserves. However, Korea, Thailand and Malaysia held significantly excessive reserves while other emerging countries such as Chile, India, Poland, China, Czech and Venezuela also had substantial excess reserves. The excessive reserves might have been due to the 1997–98 crisis in East Asia, which had brought significant changes in the demand for international reserves, increasing the hoarding over time (Aizenman & Lee, 2007).

Despite the Asian currency crises in the late 1990s, it does not imply that the emerging economies must implement policies to increase reserves continuously because it would result in an opportunity cost (International Monetary Fund, 2004). Alternatively, they should opt for liquidity enhancing policies (Bird & Rajan, 2003). It is worth to mention that there are three tiers of liquidity the countries can rely on in times of crises such as: international reserves, regional liquidity arrangements, and conventional IMF lending (Bird & Rajan, 2003). Considering the opportunity cost and the alternative liquidity sources, though reserves are the most liquid resources, their holdings are not always an ultimate and wise decision because the central banks can turn to regional liquidity arrangements and the IMF lending (Bird & Rajan, 2003).

2.6. Reserve accumulation in East Asia, Pacific, and South Asia

As of 2017, the reserves holdings excluding gold of the sampling countries in East Asia, Pacific, and South Asia are in average 22% of their respective GDP, with Bhutan and Cambodia hold the reserves approximately 50% of their GDP, respectively (Figure1).



Source: World Bank Open Data, 2018

Moreover, as of 2017, the international reserves holdings of those countries could cover their imports in average for roughly 5 months (Figure2), indicating an adequate reserves holdings based on the rules of thumbs of 3 months of imports.

In Figure 3, the average ratio of total reserves to broad money of those countries as of 2017 is around 40%, suggesting the adequacy of reserves based on the rules of thumbs of only 20%.

2.7. Optimal holding of reserves

The optimal level of reserve holding for a country depends on its potential shocks, exchange rate regimes and access to international capital (International Monetary Fund, 2011). Optimal holding of reserves is closely related with government size in small states, specifically the government spending in simulation, and especially its fiscal stance (Moore & Glean, 2016). The optimal reserve holding level is the import coverage of 25 weeks; however, with prudent fiscal stance, foreign direct investment inflows and less frequency of natural disasters, the optimal level could decrease to 19 weeks (Moore & Glean, 2016). While many small states are holding fewer reserves than 25 weeks, it does not mean these countries should begin accumulating more reserves immediately. The finding should be the target during periods of economic growth or expansion (Moore & Glean, 2016).

Moreover, Nitithanprapas and Willet's study (as cited in Bird & Rajan, 2003) suggested that the countries with floating exchange rate should hold reserves relative to import for 29 weeks while those with managed floating exchange rate should hold reserves relative to imports for 35 weeks.

Furthermore, a panel data of 32 middle-income countries from 1980 to 2004 either in the same region or in the same income group level recommended that reserves should cover about 6.3 months of imports, 534% of short term foreign debt and 2% of M2 (Prommawin, 2013).

2.8. Models built on the adequacy of foreign reserves

Recently, numerous models have been developed to determine suitable level of reserves through optimization. The models generally consider benefits and costs of holding reserves (International Monetary Fund, 2011), and sensitivity analysis of demand for reserves (Bird & Rajan, 2003). Demand for reserves is a function of economic size, current and capital account vulnerabilities, and exchange rate flexibility (International Monetary Fund, 2004). In addition, IMF's assessments on a country's vulnerabilities to crises are: reserve management, macroeconomic policies, foreign exchange rate regimes, and financial sector soundness and debt management (Bird & Rajan, 2003).

In Heller's study in the early 1960s (as cited in Bird & Rajan, 2003), the model compared the actual reserves and optimal reserves based on the opportunity cost assumption of holding excessive reserves. Nonetheless, Machlup's study (as cited in Bird & Rajan, 2003) stated that no level of reserves is enough because monetary authorities prefer the growth of reserves year by year, depending on the formula: $\text{Reserve}(t+1) = \text{Reserve}(t) + \text{growth factor}$.

In Prabheesh et al. (2007) and Shegal and Chandan's (2008) studies on foreign reserve adequacy in India (as cited in Panda & Trivedi, 2016) applied the same approaches namely, Johansen's cointegration analysis and Vector Error Correction Model. Both studies had complementary findings in that Prabheesh et al. (2007)

concluded that reserve accumulation in India was highly sensitive to current and capital account vulnerabilities and less sensitive to its opportunity cost. Therefore, a more active reserve management practice was crucial. Moreover, Shegal and Chandan (2008) found that the main purpose of reserve holding was precautionary, but high economic growth decreased reserve holding as reserve levels were negatively correlated with GDP, which was somewhat counterintuitive to the finding of positive correlation between GDP and demands for reserves (International Monetary Fund, 2004).

2.9. Problems around practicality of reserves

Reserves can be insufficient to target exchange rate stability. For example, United Kingdom lost approximately £3.3 billion in an attempt to maintain the pound sterling above its agreed lower limit in European Exchange Rate Mechanism in 1992, and had to withdraw the pound sterling from the mechanism after the failure (Zurlinden & September, 1993).

In principle, the adequacy of reserves is assessed by their capacity to prevent or mitigate external shocks. However, in practice, other types of foreign assets or contingent credits have been used to complement reserves in addressing external shocks because not all assets held in reserves may prove liquid and available in a crisis (International Monetary Fund, 2011). Besides reserves, the alternative instruments are central bank swap lines, contingent credit lines, commodity price hedging, and sovereign wealth fund assets (International Monetary Fund, 2011).

III. DATA AND METHODOLOGY

Our panel has been constructed out of 10 countries spanning over the period of 1992-2017 (East Asia, Pacific, and South Asia: Bhutan, Cambodia, Indonesia, Lao PDR, Mongolia, Myanmar, Philippines, Sri Lanka, Timor-Leste and Vietnam). These countries are either in the lower middle income group or in the same region.

The model we are estimating is the following:

$$y_{it} = \beta_0 + \beta_1 \ln(pop_{it}) + \beta_2 \ln(r_{GDPCapita_{it}}) + \beta_3 REER_{it} + \beta_4 \left(\frac{NetInflow}{GDP}_{it} \right) + \beta_5 \ln(r_{export_{it}}) + \beta_6 \ln(r_{import_{it}}) + \beta_7 \ln \left(\frac{ExtDebt}{GDP}_{it} \right) + \beta_8 \ln(Chito Index_{it}) + X'_{it}\alpha + \theta_i + \theta_t + u_{it},$$

The explanatory variables included in our regression equation are Population, Real GDP per capita, Real Effective Exchange Rate (REER), Net inflow to GDP ratio, Real export (in 2010 prices), Real import (in 2010 prices), External debt to GDP ratio, and Chito index (a measure of financial openness).

Panel Fixed Effect estimation allows us to control the unobserved time-invariant determinants that might affect the levels of reserve holdings (country size, geographical condition, and many others). We also endow the model with time dummies (θ_t) to control for the common shocks. An example of such could be Asian Financial Crisis (1997-98), which might have influenced the hoarding of reserves in the later years for precautionary purpose.

The variables' definitions are given in Appendix 1. The table below presents the summary statistics for all the variables.

Table 1: Summary Statistics

Variable	(1) Obs	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max
id	260	5.5	2.877821	1	10
y	246	1.15E+10	2.35E+10	1.64E+07	1.27E+11
gdp	243	8.15E+10	1.75E+11	2.35E+08	1.02E+12
yreal2010	246	1.17E+10	2.25E+10	2.35E+07	1.13E+11
ygd	238	0.18074	0.156074	0.009544	0.723276
t	260	2004.5	7.514465	1992	2017
pop	260	4.85E+07	6.74E+07	514877	2.64E+08
gdpcap2010	251	1684.654	1003.48	209.2652	4130.663
netinflgdp	236	3.458545	5.525595	-37.1657	43.91211
exp2010	191	3.86E+10	5.73E+10	4.25E+07	2.37E+11
imp2010	191	3.99E+10	5.60E+10	3.26E+07	2.24E+11
impgdp	241	0.461004	0.227387	0.000647	1.585936
expgdp	241	0.355832	0.194497	0.000995	1.015553
reer	234	104.3709	16.69105	46.44	162.75
chitoindex	219	-0.33799	1.15579	-1.91043	2.359998
chitonormal	216	0.37333	0.268989	0	1
extdebtm2	217	2.115514	2.659424	0.003642	17.95562
log_pop	260	16.4054	1.900983	13.15168	19.39143
log_gdp~2010	251	7.222301	0.691961	5.343602	8.326193
log_yre~2010	246	21.46524	1.99551	16.97061	25.45254
log_exp2010	191	22.69999	2.37051	17.56594	26.19038
log_imp2010	191	23.0795	1.910184	17.30097	26.13343
exdebtgdp	216	0.657494	0.39978	0.095743	2.465984
neersd	198	9.243807	19.35128	0.621067	107.2192

IV. RESULTS AND DISCUSSION

In this section, the main regression result is reported. The Panel Fixed Effect (column 1), Panel Fixed Effect with time dummies (column 2), and Panel Fixed Effect clustered by countries (column 3) yield consistent results except the significance of the percentage change in the population, real GDP per capita, and net inflow to GDP ratio on the accumulation of reserves.

Considering the distinct characteristics of each country, the Panel Fixed Effect shows that the percentage increase in population significantly increase the foreign reserves shares while the percentage increase in GDP per capita significantly decreases the reserve holding levels. However, when time dummy is included, the percentage in population is not significant anymore while log real GDP per capita also decrease its significance. Despite this, the result implies that as the economic wellbeing of the people get better, there is less need for the central banks to hold more reserves. Our finding of the influence of real GDP per capita on reserves holdings is contradict to our hypothesis and that of IMF but correspond to Shegal and Chandan (2008).

The highly significant certainty of the increase in net inflows to GDP which will increase the reserve levels, backed up by the positive coefficients of the percentage change in real exports and imports along with that of Chito index which is a measure of financial openness, infers that the levels of trade openness and financial openness boost the reserves accumulation. The finding is in line with our hypothesis and strongly supported by the extensive existing literatures.

The effect of real effective exchange rate on international reserves is negative as expected though it is not statistically and economically significant. Moreover, taking external debts into consideration, there is some probability that a country should hold more reserves.

To address serial correlation problem which make standard errors lower than they actually are, we account for potential serial correlation by clustering standard errors at the country-level. However, the results remain the same though the significance level of log population, log real GDP per capita, and real effective exchange rate decrease compared to the Panel Fixed Effect. The interesting result is that the adjusted R^2 increase to 44.8%, indicating that there may have been a serial correlation problem.

Table2: Determinants of Reserve Holdings

Outcome variable: ReservesminusGold/GDP

	(i) ygdp	(ii) ygdp	(iii) ygdp
log_pop	0.453*** (0.094)	0.253 (0.184)	0.453* (0.130)
log_gdp~2010	-0.200*** (0.056)	-0.313** (0.099)	-0.200* (0.082)
reer	-0.000 (0.000)	-0.001 (0.001)	-0.000 (0.001)
netinflgdp	0.004*** (0.001)	0.004*** (0.001)	0.004** (0.001)
chitoindex	0.011 (0.007)	0.016 (0.011)	0.011 (0.008)
log_exp2010	0.079* (0.032)	0.080* (0.036)	0.079* (0.028)
log_imp2010	0.005 (0.039)	0.025 (0.044)	0.005 (0.053)
exdebtgdp	0.021 (0.023)	0.022 (0.034)	0.021 (0.057)
Panel FE	Y	Y	Y
Time FE	N	Y	N
N	158	158	158
adj. R-sq	0.420	0.385	0.448

Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

V. CONCLUSION

Our study has found that the significant determinants of foreign reserve accumulation in East Asia, Pacific and South Asia are the percentage change in populations and real GDP per capita, net inflows to GDP, and the percentage change in exports. Moreover, other factors such as real effective exchange rate, chitoindex, percentage change in imports, and external debts to GDP, though are not significant are consistent with our expectation.

In conclusion, population, trade openness, financial openness and external debt increase foreign reserves holdings while the wellbeing of the people and the appreciation of exchange rate decrease the incentives to accumulate international reserves.

Appendix 1

id = country

y = total reserves minus gold comprise special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Gold holdings are excluded. Data are in current U.S. dollars.

GDP = nominal gross domestic products in USD.

yreal2010 = reserves minus gold, deflated by the U.S GDP deflator (2010=100).

ygdpcap = reserves minus gold in current USD over GDP in current USD.

t = year

pop = total population based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values shown are midyear estimates.

gdpcap2010 = real GDP per capita in constant 2010 U.S. dollars.

netinflgdp (foreign direct investment, net inflows (% of GDP)) = net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.

exp2010 = exports of goods and services represent the value of all goods and other market services provided to the rest of the world. Data are in constant 2010 U.S. dollars.

imp2010 = imports of goods and services represent the value of all goods and other market services received from the rest of the world. Data are in constant 2010 U.S. dollars.

impgdp = ratio of current imports to current GDP in current USD.

expgdp = ratio of current imports to current GDP in current USD.

reer = Real Effective Exchange Rate (REER), annual real effective exchange rate.

Source: Darvas, Zsolt (2012a) 'Real effective exchange rates for 178 countries: A new database', *Working Paper* 2012/06, Bruegel, 15 March 2012. Updated: 28 June 2018.

chitoindex = a measure of the extent of openness in capital account transaction based on the information from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Source: A New Measure of Financial Openness by Menzie D. Chinn* University of Wisconsin and NBER, and Hiro Ito, Portland State University, May 23, 2007.

chitonormal = normalized version of chitoindex bounded from [0,1].

extdebtm2 = ratio of external debt over broad money in current U.S. dollars.

log_pop = total population, logged.

log_gdp~2010 = GDP per capita in 2010 constant price, logged.

log_yre~2010 = reserves minus gold deflated by 2010 deflator, logged.

log_exp2010 = exports in constant 2010 U.S. dollars, logged.

log_imp2010 = imports in constant 2010 U.S. dollars, logged.

exdebtgdp = ratio of external debts over GDP in current U.S. dollars.

neersd = annual standard deviation of monthly nominal effective exchange rate (NEER). Source: Darvas, Zsolt (2012a) 'Real effective exchange rates for

178 countries: A new database', *Working Paper* 2012/06, Bruegel, 15
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