WHAT DRIVES ASIAN INTERNATIONAL RESERVES ACCUMULATION IN THE POST-FINANCIAL CRISIS OF 1997-98

Md. Ubaydullah[1]
K. M Nafiz Ifteakhar Tulon[2]

Abstract

Global reserves accumulation experienced impressive gains following the late 1990s Asian financial crisis that undermined not only the Asian economies but also the world. Since then, only 49 Asian countries are contributing more than 60% of global hoarding and this trend has been considered from various insights of the international policy agenda. But the logic behind this enormous accumulation is still a matter of serious debate among researchers which is examined in this paper. The empirical estimation based on the unbalanced panel of 49 Asian countries from the period of 1999-2021 confirms precautionary motive as the best illustrator of holding reserves. Asian countries hold reserves as a safeguard against temporary external imbalances and uncertainty in the balance of payment. Against the popular myth that export, or GDP growth has no effect on reserve accumulation. However, exchange rate stability has some effect.

Keywords: International Reserves, Asian Financial Crisis, Precautionary Motive, Mercantilist Motive, Monetary Authority

Introduction

The East and Southeast Asian financial distress which is known as the Asian financial crisis (AFC) of 1997-98 has brought significant changes in the demand for international reserves (IR). After the crisis, many countries shifted to a floating exchange rate regime that demands theoretically low reserves although the opposite has happened. In fact, we see a sharp growth in global total international reserves both in actual and relative terms and they have reached 14.8 trillion dollars in 2021 (Figure: 1). In 1997, the global reserves to Gross Domestic Product (GDP) ratio was 5.90% which was 9.21% for Asian economies. But after the crisis,

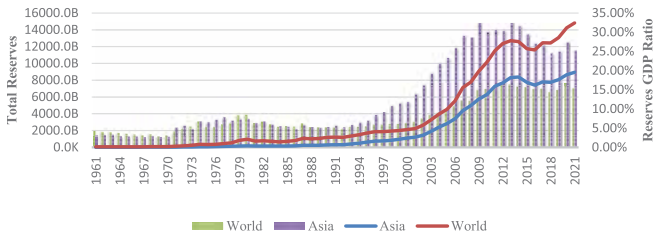
[1] **Md. Ubaydullah,** Joint Director, Bangladesh Bank, Dhaka, Bangladesh. Email: ubaydullahdu@gmail.com

[2] **K. M Nafiz Ifteakhar Tulon,** Assistant Professor, Institute of Health Economics, University of Dhaka, Dhaka-1000, Bangladesh. Email: nafiz.ihe@du.ac.bd

Social Science Review [The Dhaka University Studies, Part-D], Vol. 40, No.1, June 2023
DOI: https://doi.org/10.3329/ssr.v40i1.69103

Asian reserves accumulation increased dramatically (Aizenman & Lee, 2007) and now it is 25.3% of its GDP. From 1997 to 2021 Asian output increased by 314% whereas accumulation of reserves increased by 1062% and it was 694% for global accumulation and 435% excluding Asia. So, Asian reserve accumulation has a scalation effect on global accumulation as Asia solely comprises more than 60% of global reserves holding since 2004. At the end of 2021 Asian reserves holding stood at 8952 billion US dollars which is 11.6 times larger than the holding in 1997. By the current sum of reserves, the 49 Asian countries can meet their 14 months of import obligations which was 5.4 in 1997 (Appendix, Table A4). In recent issues of international economics, this rapid increase in IR is considered a matter of surprise and controversy same time.

FIGURE 1: RESERVES COMPARISON



Source: Author's calculation based on World Development Indicators (World Bank)

The Asian financial crisis has so many salient features which help explaining the behavioural changes in reserve accumulation. After the Tequila crisis of 1994, the East Asian economies were considered minimally susceptible to the possible accompanying risks of hot money. There was also a widespread view that despite their openness to international trade and finance, the East Asian countries had a stable fiscal policy, and good prospects for future growth. These presumptions were overestimated, and the crisis (1997-98) forced the markets to update their views. The crisis decreased investment substantially and consequently, national output shrunk. The financial stability of some countries was jeopardized. As a result, almost all of the affected countries underwent a huge adjustment process. They adopted the modern version of monetary mercantilism. Crisis faltered their growth and they switched to hoarding IR which is soared due to concerns about external competitiveness in exports (Aizenman & Lee, 2008). Then, output contraction was reversed and within a few years, they were back to their previous growth paths with improved or at least pre-crisis levels of financial integration. The mixed responses make it difficult to explain their reserve holding motive whether precautionary (self-insurance against future sudden stops) or mercantilist (currency depreciation to

export growth) (Aizenman & Lee, 2008). The precautionary motive is explained as a hedge against the balance of payments (BOP) anomalies whereas the mercantilist motive is to safeguard the export competitiveness (Delatte & Fouquau, 2011) as a consequence of reserve accumulation export growth may be benefited by averting or at least reducing domestic currency appreciation (Dooley, Folkerts-Landau, & Garber, 2003). The AFC is also explained from the viewpoint of inflation-related revenues (Burnside, Eichenbaum, & Rebelo, 2001). Sometimes it is also described that to maintain inflation and exchange rate stability central banks accumulate reserves (Pina, 2015). But whatever the motives, due to the limited access of emerging economies' to the international capital markets, hoarding a sizeable reserves has proved as an effective strategy for them (Aizenman & Marion, 2003).

Hence, the reserve-holding motivation of Asian economies is yet to be resolved by comparing all the traditional motives. Understanding motives for international reserve holding is crucial for the macroeconomic policies of any country for example monetary policy, inflation control, etc. Against this backdrop, the current study has attempted to explain whether the Asian reserve accumulation could be explained as a safeguard against possible crisis (precautionary motive) or facilitating trade (mercantilist viewpoint) or lowering inflation (monetary perspective)[1]. Hence, we focus on traditional variables which are widely and robustly used in reserve literature to investigate the motive of reserve-holding behaviour of 49 Asian countries for the post-crisis period of 1999 to 2021. The organization of this paper is as follows. A brief review of relevant studies is given in the next chapter. The methodology and data are mentioned in chapter 3. Chapter 4 contains the main results and the discussion about the results. Concluding remarks are offered in Section 5.

Literature Review

International Reserves (IR) refers to ". . . those external assets that are readily available to and controlled by monetary authorities for meeting the balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy and serving as a basis for foreign borrowing)" (International Reserves and Foreign Currency Liquidity, 2014).

The issue related to international reserves attract researchers from the very beginning of the nineteenth century and was widely discussed theoretically and empirically where (Heller H. R., 1966) is assumed as the pioneer. Based on

the traditional cost-benefit analysis and using a panel of 60 cross-country data for the period of 1949-63 Heller explained the demand for IR as an optimizing approach. According to him reserves give utility to hoarding countries by reducing adjustment costs. But reserves are part of the national assets which could have been better used in domestic consumption or investment and growth. So, there is an opportunity cost of holding reserves. The net social rate of return on capital is measured as the opportunity cost, due to the complexity which is proxied by long-term government bond rate. A rise in the opportunity cost reduces the demand for IR as the alternative uses are more profitable. However, a nation will hold reserves to minimize its total adjustment cost of financing international payment imbalances. Given some minimum need, a precautionary holder of reserves will find that the marginal benefits of holding last unit of reserves declines, whereas the marginal costs of not keeping reserves rises. Heller's attempt is the first in reserve literature to consider both the marginal benefit and cost of holding reserves simultaneously (Hamada & Ueda, 1977).

Despite opportunity cost countries are holding reserves due to the welfare loss associated with the low amount of reserves (Aizenman & Lee, 2007). Every country needs foreign currencies to maintain its daily transaction with foreign counterparts but a sudden stop in receiving foreign currencies from outside may trouble the economy and entail huge costs. To reduce the output costs of sudden stop developing countries hoard reserves. Their primary motive for holding reserves is to finance temporary external imbalances which is a precautionary motive for holding reserves. Until the development of the modern international capital market, this was the most important part of the balance of payment transactions (Cheung & Ito, 2009). Holding reserves for emergencies and speculative attacks is also included in precautionary motives.

Throughout the 1980s and early 1990s, the International Monetary Fund (IMF) advised developing countries to hold reserves equivalent to at least three months of imports and most of the countries accumulated their reserves as self-insurance against both current and capital account shocks which is a precautionary purpose. But the 1990s crises (Tequila-1994 & Asian 1997-98) increased the importance of insurance against capital account shocks and countries were advised to follow the Greenspan-Guidotti rule (which emerged in 1999) to hold reserves as the full coverage of a country's short-term external debt. This can be viewed as self insurance against sudden stops which is also explained as a precautionary motive for holding reserves.

In previous literature, a country's external imbalance and vulnerability are measured by the import propensity which is also proxied as a measure of trade openness (Frenkel, 1983; Aizenman & Marion, 2003). Due to the scarcity of data average propensity to import and import GDP ratio is used instead of marginal propensity (Flood & Marion, 2002) and this is counted as a robust estimator to understand the precautionary motive of holding reserves (Cabezas & Gregorio, 2019).

A country's position in the balance of payment is also an important source to understand the possibility of falling into the risk of international imbalances. The wave of capital flows to developing countries especially in Asia which started in the 1990s led to a different role of IR in a financially globalized world. The allowance of cross-border capital flows rises the BOP vulnerability and vice versa. The evolution of international capital mobility especially from the post-war period is in principle closely related to international liquidity in other wards to IR (Taylor, 1996). But the direction of reserve demand due to the introduction of capital mobility is inconclusive. Capital mobility allows countries easier access to international borrowing and external financing of their deficits at least in part. Countries with higher financial openness are more prone to a BOP crisis. So, financially more open countries need more reserves. The uncertainty in the balance of payment is another component to quantify the precautionary motive of holding reserves (Frenkel, 1974). The reserve volatility has been taken as the proxy of the balance of payment uncertainty (Frenkel & Jovanovic, 1981). We use reserve volatility instead of the variable of financial openness because previous studies (Heller & Khan, 1978; Eichengreen & Frankel, 1996) do not find any presumption that the advent of capital mobility raises or decreases the demand for IR. Moreover, by definition, it is assumed that capital mobility is not a source of vulnerability, but exchange rate volatility could be caused by a high degree of capital mobility. The increased capital mobility along with exchange rate flexibility does not reduce the need for IR. Despite access to international capital markets, developing countries will bear the cost of holding reserves as an insurance premium for better protection against shocks in a financial crisis, and it is proven in the late 1990s crises as well as during the crisis of 2008 that emerging countries with relatively bigger reserves have endured the crises considerably better than those with moderate reserves (Dominguez, Hashimoto, & Ito, 2012). So, financial openness is also an important indicator of the precautionary self-insurance motive of reserves (Cabezas & Gregorio, 2019) which will be checked here as a control variable.

On the other hand, to keep the pace of export growth countries always prefer a stable and depreciated exchange rate. On the other hand, to maintain exchange rate

stability an adequate level of foreign exchange reserve is a must. In this simplistic explanation motive of holding reserves is export growth by stabled and depreciated exchange rate. In line with the previous literature (Delatte & Fouquau, 2011; Ghosh, Ostry, & Tsangarides, 2017) export growth and exchange rate variables are taken to examine the effect of mercantilist motive on reserves.

Reserve accumulation is also described as a central bank's policy consequences (Pina, 2015). At the time of crisis central banks of developing economies want to manage inflation, exchange rate, and support the financial sector. Keeping a large stock of reserves reduces the chance of crisis significantly (Obstfeld, Shambaugh, & Taylor, 2010; Dominguez, 2012) and lower variability in the rate of inflation. So, the higher the international reserves the lower the possibility of crisis and the lower disruption in the inflation rate. We will check this monetary perspective of reserve holding by regressing inflation volatility.

So, our goal is to check the reserve-holding motive of Asian economies in the post-crisis period. Our contribution to the existing reserve literature is examining both precautionary, mercantilist, and monetary perspectives of reserve holding together. There are no study considering these three motives together. Moreover, we estimated our regression with the most recent dataset consisting of all the 49 Asian countries.

Methodology

In today's world, every country is interconnected, and they need foreign currencies to meet their international payment obligations. But there is the persistent probability of falling into a crisis at any time. Financing imports and foreign debt obligations are the most important and straightforward cause of holding reserves. At the time of crisis, foreign inflows are typically low, but outflow pressure might be in rising mode. To settle foreign outflows, a sizeable number of inflows are a must. As a result, countries with insufficient reserves might fall into trouble to finance their foreign obligations. To run with temporary external imbalances economies might cut aggregate expenditure but this process definitely entails welfare loss. This loss may reduce or even eliminate proportionately with the amount of reserve hoarding. Hoarding reserves to protect against possible high expenses that may arise in the future is known as the precautionary motive of holding reserves.

On the other hand, hoarding of IR is also viewed as a part of the development strategy. A large stock of reserves keeps exchange rates stable and defends currency

appreciation which makes the country relatively competitive in the international market and promotes export. A good amount of reserves also plays a key role as collateral for foreign direct investment (FDI). A stable exchange rate with sufficient stock of reserves attracts FDI which is regarded as important for capital formation that may boost economic growth in developing countries (Makki & Somwaru, 2004). So, export-led growth is sometimes attributed as a consequence of reserve accumulation. This reserve-hoarding behaviour is explained as the mercantilist approach of reserve accumulation that is related to the industrial policy of a country that may have negative externalities on other partner countries (Aizenman & Lee, 2007).

Moreover, as custodians of external assets central banks have their own policies for reserve accumulation keeping into mind their key role of inflation targeting and desirable exchange rate, and this is known as the monetary motive of holding reserves.

To empirically examine all these motives of holding reserves for Asian region after the financial crisis of 1997-98 this study is attempted to estimate the following regression using a panel data of 49 Asian countries (see Table A5 of Appendix) with the period of 1999 to 2021.

$$lnr_{i,t} = \xi_0 + \beta_1 \ln(impgdp_{i,t}) + \beta_2 \ln(rvol_{i,t}) + \varphi_1 expgr_{i,t} + \varphi_2 \ln(neer_{i,t}) + \omega_1 \ln(infvol_{i,t}) + Z_{i,t}\gamma + \alpha_i + \varepsilon_{i,t} \quad \text{---------- (1)}$$

Where, *i* (= 1, 2,….., N) is the number of cross-sections, and *t* (= 1, 2,…..,T) is the number of time series. $impgdp$, $rvol$, $expgr$, $neer$ and $infvol$ stand for import GDP ratio, reserve volatility, export growth, nominal effective exchange rate and inflation volatility, respectively. $Z_{i,t} = \{Z_{i,k,t}; k = 1, \ldots, N_z\}$ contains control variables. β, φ, ω and γ are the associated coefficient vectors of precautionary, mercantilist, and monetarist motives of holding reserves and control variables, respectively.ξ_0 is the constant term. α_i is country fixed effect and $\varepsilon_{i,t}$ is the idiosyncratic error term. All variables except the export growth are taken in the natural log. As we have used long panel data it was important to check whether the variables, we had used were stationary or not. Table A2 in the appendix showed the result of augmented Dickey-Fuller tests for stationary for all the variables which confirmed that all the variables are stationary at 10 percent or lower level of significance. The presence of the - country-fixed effect might result in biased estimates of the regression parameters. To control for the country-fixed effect, we

used the fixed effect estimator. Fixed Effect Estimator is basically OLS applied in the time-demeaned data.

$$\overline{lnr_\iota} = \xi_0 + \beta_1 \overline{\ln(\iota mpgdp_\iota)} + \beta_2 \overline{\ln(rvol_\iota)} + \varphi_1 \overline{expgr_\iota} + \varphi_2 \overline{\ln(neer_\iota)} + \omega_1 \overline{\ln(\iota nfvol_\iota)} + \overline{Z}_\iota \gamma + \alpha_i + \overline{\varepsilon_\iota} \quad \text{---- (2)}$$

Here equation 2 represents time average regression where the time average of each of the variables was used. Because of being time constant the time average of fixed effect 'α_i' would be the same. Time-demeaned regression would be obtained by subtracting 'equation 2' from 'equation 1' which will be removed the fixed effect 'α_i ' in the process and estimates would be unbiased. We performed the houseman test to confirm that the fixed effect model was appropriate under the current setting. As we used a long panel there could be a possibility of the presence of autocorrelation in the error term which resulted in the invalidation of the default standard error of the estimated parameters. To control for autocorrelation and heteroskedasticity we used robust standard error which allows for autocorrelation and heteroskedasticity in the error term.

Data and Variables

To investigate the reserve holding motivation this study uses unbalanced panel data from 49 countries of the Asian continent from the period of 1999 to 2021. A list of countries is presented in Table A5 of the Appendix. 1999 has taken as the starting period as 1997-98 was the crisis time (Cheung & Ito, 2009). Except for NEER the source of the data is the World Development Indicators (WDI).

The international reserves are defined differently in previous literature. Most opted (Heller H. R., 1966) emphasizes two qualities of IR: (i) "they must be acceptable at all times to foreign economic units for payment of financial obligations and (ii) their value- expressed in foreign units of account- should be known with certainty." But the total official reserves are the broadest definition of IR which include both currency and non-currency reserves (gold, Special Drawing Rights (SDR), the reserve position at the IMF, and other reserve assets) (Dominguez, Hashimoto, & Ito, 2012).

Trade openness is proxied by the propensity to import which is calculated as the import GDP ratio due to the data unavailability. Making slight changes to the technique of (Frenkel & Jovanovic, 1981) reserve volatility and inflation volatility is calculated by three years' standard deviation of reserves including gold and inflation rate, respectively. Export growth is calculated from the data of current

export receipts and services and two years lag is taken in regression to control possible endogeneity issues (Aizenman & Lee, 2007). After (Ghosh, Ostry, & Tsangarides, 2017) nominal effective exchange rate (NEER) volatility is computed on annual basis by taking the standard deviation of the monthly NEER using the data set of (Darvas, 2012).

Financial openness is proxied by the Chinn-Ito Financial Openness Index (kaopen) (Chinn & Ito, 2006). This is an index measuring a country's degree of capital account openness and is viewed as a de jure index on financial openness (Wijnholds & Kapteyn, 2001). The larger the value of this index indicates the higher the level of capital account openness. This index is based on the binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (Chinn & Ito, 2022).

The summary statistics of the data set are included in the Appendix, Table A1.

Results and Discussion

To examine the explanatory variables of international reserves in post crisis period of Asian countries, this empirical study has followed the fixed effect model. Table 1 represents the estimation results for the period 1999-2021. We have run 5 models with different set of variables as shown in the following Table 1.

Table 1: Estimation Results (1999-2021)

Specification	Case 1	Case 2	Case 3	Case 4	Case 5
ln(Import/GDP)	0.437*** (0.135)			0.458*** (0.148)	0.552*** (0.131)
ln(Res vol)	0.205*** (0.032)			0.207*** (0.036)	0.207*** (0.037)
Expgrowth		-0.0000003*** (0.000000009)			-0.0005 (0.0007)
ln(NEER vol)		-0.077*** (0.021)			-0.044** (0.019)
ln(Inf vol)			-0.043* (0.023)	0.015 (0.019)	0.0130 (0.021)
Constant	-5.529*** (0.679)	-1.635*** 0.011	-1.588*** (0.012)	-5.562*** (0.734)	-5.530*** (0.766)
Observations	899	848	957	860	793

# of countries	45	41	45	43	40
R-squared	0.346	0.062	0.019	0.412	0.485

Notes: Robust standard errors clustered by countries are given in parentheses. *, **, and *** indicate significance at the 10%; 5%; and 1% levels, respectively.

Description

Table 1 shows the determining factors that affect the reserve holding behaviour of Asia in post-crisis period, 1999-2021. In our specification import GDP ratio and reserve volatility are representing the precautionary motive, the rate of export growth lagged by two years and volatility in the nominal effective exchange rate are for the mercantilist motive and inflation volatility captures the monetary perspective of holding reserves. Following the standard approach, the described three motives of holding reserves are regressed first separately and then combinedly. Cases 1, 2, and 3 are shown separate effects and case 4 shows the joint effect.

The variable for external imbalance which is proxied by the import GDP ratio is found positively and significantly related to reserves which are supported by (Aizenman & Marion, 2003; Frenkel & Jovanovic, 1981). This is because in line with the IMF prescription since the 1980s central banks throughout the world hold international reserves keeping the monthly amounts of reserves in consideration. Economies also care about the months of import they can finance in absence of export receipts at the time of a current account crisis. Recent work for developing and emerging economies (Cabezas & Gregorio, 2019) found negative import GDP as a measure of precautionary motive but insignificant in almost all of the cases which is unlike in previous studies.

The reserve volatility has been taken as the proxy of the balance of payment uncertainty and secured an expected positive sign- the more instability in the country's balance of payment the more motivation to hold reserves for precautionary purposes. Under the stochastic framework (Frenkel & Jovanovic, 1981) illustrated reserve volatility as a proxy for the balance of payment uncertainty and argue the positive impact of reserve volatility on reserve demand. (Flood & Marion, 2002) extends the buffer stock model of (Frenkel & Jovanovic, 1981) and finds that reserve volatility significantly increases reserve demand. Recent works including (Cheung & Ito, 2009; Cheung & Qian, 2009) also find a positive and significant reserve volatility coefficient.

Export growth, lagged in two years, and volatility in the nominal effective exchange rate is taken to identify the mercantilist effect of hoarding reserves. Export growth is highly significant in a separate model with truly trivial effect in magnitude, but the sign is unexpectedly negative. No statistically significant relationship is found between reserves and export growth in the combined model. But in the post-crisis period we see a sharp rise both in reserve accumulation and export receipts of Asian economies (Appendix Table A4) although the statistical relationship is insignificant and supported by (Delatte & Fouquau, 2011). Sometimes GDP growth rate is also used as a proxy to identify the mercantilist motive of holding reserves. But GDP growth lagged in two years is also found insignificant (Appendix Table A4). At the same time, the nominal effective exchange rate is found as a significant predictor of reserves in all cases. The negative coefficient of NEER volatility means lower exchange rate volatility is associated with a higher demand for reserves and vice versa. Due to the less volatility in the exchange rate those countries need less intervention of monetary authority in the exchange rate market which leads to a higher stock of reserves. (Ghosh, Ostry, & Tsangarides, 2017) find a negative and significant coefficient of NEER volatility in their study. This is also consistent with (Flood & Marion, 2002; Cheung & Ito, 2009). Although there is no direct effect of export or GDP growth in reserve accumulation, an open market operation of monetary authority helps to keep the exchange rate at the desired level which may have some effect on export proceedings as well as on national output. Though NEER is significant with the desired sign but the main variable for mercantilist motive, export growth, is insignificant. So, we cannot say conclusively that the reserve accumulation of Asian countries was driven by mercantilist motives. If there are still some mercantilist motives but that effect is very little which is also proved by our regression in case 2. Though it is against the intuition the negligible effect of mercantilist motive is not new for manufacturing exporters (Cabezas & Gregorio, 2019) and Asia exports mostly manufacturing goods.

The inflation volatility is found insignificant in all cases which denies any relation of inflation targeting with reserve holding for Asian countries. Most of the reserve literature found a significant positive relation between reserves and broad money and excessive money supply rises inflation. At the same time, a certain level of inflation is expected for the growth of developing economies. As the Asian economies are net exporter maintaining sustained growth were more important rather than inflation. That could be a probable reason for the insignificant relation between reserves and inflation volatility.

Finally, we can say that in our simplified specifications precautionary motive of holding reserves is playing the most key role in Asian economies as compared to mercantilist and monetary perspectives. Moreover, the effect of the precautionary motive is more visible and stronger compared to others. Previous studies notably (Aizenman & Lee, 2007) find the same result for developing countries.

Robustness Check

To check robustness, we added some traditional variables. Financial depth measured by the ratio of broad money (i.e., M2) and GDP as well as financial openness proxied by the 'Chinn-Ito Openness Index' were used as measures of the precautionary motive of holding reserves. The inflow of foreign direct investment is another indicator of the mercantilist motive of holding reserves. The results were consistent with our main models as shown by case 4 and case 5 in Table A3 of the Appendix. We also have included interest rates (i.e., both deposit and lending rates) in our model assuming interest rates might affect IR. At the same time, interest rates are correlated with both exchange rates and inflation. Adding those variables does not change the baseline results of our main model (Please see case 6 and case 7 of Table A3.

China receiving WTO membership after the crisis could change the reserve holding motives of China. This could create ambiguity in the estimation as China is the largest reserve holders as well as biggest exporter of the world. At the same time, Japan is the 2nd largest reserve holders and 4th largest exporter. Hence, we check our regression by excluding China and Japan. Regression by excluding these two countries also generates the same results (As shown by Case 8 and Case 9 of Table A3 in the Appendix). In all cases, the precautionary motive plays the most prominent role in holding reserves. The mercantilist motives may have had some effects on IR but those were insignificant, and the effect was exceedingly small in size (Please see Table A3 of Appendix).

Conclusion

Our study followed a very simplified model using the fixed effect estimator to examine the role of precautionary, mercantilist, and monetary motives for holding reserves. It is worth mentioning that there could be a few shortcomings in our estimated models. For instance, biased due to omitting other important variables. However, for ensuring robustness we have run several models by including different sets of independent variables and found consistent results (the results are shown in the Appendix). The presence of measurement error in the dependent variables

due to the possible foreign exchange holding by households and other business corporations could also result in a biased estimation of the regression coefficients. As official reserves always tend to underestimate the actual reserve, the resulted biased would be downward which implies that the regression coefficients would be underestimated. However, it would not be a big concern in our study. Since we are modelling the reserve holding motives of a country, the official reserve holdings are appropriate to be considered which only include the external assets under the control of the monetary authority of a country (International Reserves and Foreign Currency Liquidity, 2014).

Despite using a simple econometric model our findings showed important insight regarding the motives of holding foreign exchange reserves of Asian economies. We found that external imbalance and balance of payment vulnerability, the two variables associated with the precautionary motive of holding reserves, are explaining reserves holding of Asian economies which are statistically and economically more significant as compared to export growth and exchange rate variability which are the associated with the mercantilist motive. At the same time, we did not find any significant effect of the monetary perspective of holding reserves though there might have economic implications. In our model precautionary motive of holding reserves is bearing the more consistent explanation of holding reserves. However, due to having a few limitations as described earlier in the future, the result may be verified by a more advanced econometric model.

Notes

[1] The monetary perspective also described as a precautionary motive, but this inflation soothing reserve accumulation is different from conventional precautionary motive of reserve accumulation.

References

Aizenman, J., & Lee, J. (2007). International reserves: Precautionary versus mercantilist views, theory, and evidence. *Open Economies Review, 18*(2), 191-214.

Aizenman, J., & Lee, J. (2008). Financial versus monetary mercantilism: Long-run view of large international reserves hoarding. *World Economy, 31*(5), 593-611.

Aizenman, J., & Marion, N. (2003). The high demand for international reserves in the Far East: What is going on? *Journal of the Japanese and International Economies, 17*(3), 370-400.

Burnside, C., Eichenbaum, M., & Rebelo, S. (2001). Prospective Deficits and the Asian Currency Crisis. *Journal of Political Economy, 109*(6), 1155-1197.

Cabezas, L., & Gregorio, J. D. (2019). Accumulation of reserves in emerging and developing countries: mercantilism versus insurance. *Review of World Economics, 155*, 819–857.

Cheung, Y. W., & Ito, H. (2009). A Cross-Country Empirical Analysis of International Reserves. *International Economic Journal, 23*(4), 447-481.

Cheung, Y. W., & Ito, H. (2008). *Hoarding of international reserves: A comparison of the Asian and Latin American experiences* (Working Paper No. 7/2008). Hongkong: Hongkong Institute for Monetary Research .

Cheung, Y. W., & Qian, X. (2009). Hoarding of International Reserves: Mrs Machlup's Wardrobe and the Joneses. *Review of International Economics, 17*(4), 824–843.

Chinn, M., & Ito, H. (2006). What matters for financial development? Capital controls, Institutions, and Interactions. *Journal of Development Economics, 81*(1), 163-192.

Chinn, M., & Ito, H. (2022). *Notes on The Chinn-Ito Financial Openness Index*. Retrieved from https://web.pdx.edu/~ito/Chinn-Ito_website.htm.

Darvas, Z. (2012). *Real effective exchange rates for 178 countries: A new database* (Working Paper 2012/06). Brussel: Bruegel.

Delatte, A. L., & Fouquau, J. (2011). The determinants of international reserves in the emerging countries: a nonlinear approach. *Applied Economics, 43*(28), 4179-4192.

Dominguez, K. M. (2012). Foreign reserve management during the global financial crisis. *Journal of International Money and Finance, 31*, 2017–2037.

Dominguez, K. M., Hashimoto, Y., & Ito, T. (2012). International reserves and the global financial crisis. *Journal of International Economics, 88*, 388-406.

Dooley, M. P., Folkerts-Landau, D., & Garber, P. (2003). *An Essay on the Revived Bretton Woods System* (Working Paper No. W9971). Cambridge: National Bureau of Economic Research.

Eichengreen, B., & Frankel, J. A. (1996). *On the SDR: Reserve Currencies and the Future of the International Monetary System* (WP No. C96-068). California: Centre for International and Development Economics Research (CIDER).

Flood, R., & Marion, N. (2002). *Holding International Reserves in an Era of High Capital Mobility*. IMF Working Papers, (WP/02/62). Washington D.C.: International Monetary Fund.

Frenkel, J. A. (1974). Openness and the Demand for International Reserves. In *R. Z. Albier, National Monetary Policies and the International Financial System* (pp. 289-98). Chicago: University of Chicago.

Frenkel, J. A., & Jovanovic, B. (1981). Optimal International Reserves: A Stochastic Framework. *The Economic Journal, 91*(362), 507-514.

Frenkel, J. A. (1983). *International Liquidity and Monetary Control* (NBER Working Paper No. 1118). Cambridge: National Bureau of Economic Research.

Ghosh, A. R., Ostry, J. D., & Tsangarides, C. G. (2017). Shifting Motives: Explaining the Buildup in Official Reserves in Emerging Markets since the 1980s. *IMF Economic Review, 65*(2).

Hamada, K., & Ueda, K. (1977). Random Walks and the Theory of the Optimal International Reserves. *The Economic Journal, 87*(348), 722-742.

Heller, H. R. (1966). Optimal International Reserves. *The Economic Journal, 76*(302), 296-311.

Heller, H. R., & Khan, M. S. (1978). The demand for international reserves under fixed and Floating Exchange Rates. *International Monetary Fund Staff Papers, 25*(4), 623-649.

International Monetary Fund. (2014). *International Reserves and Foreign Currency Liquidity*. Washington D.C.: IMF.

Makki, S. S., & Somwaru, A. (2004). Impact of foreign direct investment and trade on economic growth: Evidence from developing countries. *American Journal of Agricultural Economics, 86*(3), 795-801.

Obstfeld, M., Shambaugh, J. C., & Taylor, A. M. (2010). Financial Stability, the Trilemma, and International Reserves. *American Economic Journal: Macroeconomics, 2*(2), 57-94.

Pina, G. (2015). The Recent Growth of International Reserves in Developing Economies: A Monetary Perspective. *Journal of International Money and Finance, 58*, 172-190. DOI: http://dx.doi.org/doi:10.1016/j.jimonfin.2015.08.009

Taylor, A. M. (1996). International capital mobility in history: The saving-investment relationship (No. w5743). Cambridge: National Bureau of Economic Research.

Wijnholds, J. O., & Kapteyn, A. (2001). *Reserve Adequacy in Emerging Market Economies* (IMF/WP/01/143). Washington D.C.: International Monetary Fund.

Appendix

Table A1: Summary Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
ln(Res/GDP)	1002	-1.601	0.832	-5.494	0.668
ln(Import/GDP)	989	-0.886	0.572	-2.853	0.793
ln(Res vol)	1003	20.950	2.243	13.957	26.884
Lagged Export Growth	995	1404.46	43964.85	-82.445	1386821
ln(NEER vol)	996	-0.511	0.780	-3.399	4.243
ln(Inf Vol)	1007	0.564	1.096	-3.688	4.150
ln(m2/GDP)	956	-0.529	0.726	-2.700	1.515
Kaopen	904	0.314	1.531	-1.924	2.347
ln(fdigdp)	973	-3.765	1.350	-9.442	-0.536
Lagged GDP Growth	1089	5.079	5.474	-36.658	53.382
ln(stdgdp)	663	-3.536	1.620	-13.007	-0.587

Table A2: Unit Root Test Results (Based on augmented Dickey-Fuller tests)

Variables	**Level**
ln (Res/GDP)	646.8863***
ln (Import/GDP)	598.0884***
ln (Res Vol)	746.8383***
Lagged Export Growth	2767.0922***
ln (NEER Vol)	2527.0056***
ln(Inf Vol)	942.3106***
ln (m2/GDP)	371.1807*
Kaopen	1287.1260***
ln(fdigdp)	1438.6563***
ln(stdgdp)	651.3568***
Lagged GDP Growth	2493.3670***

Notes: ***/**/* indicate rejection of the null hypothesis of non-stationarity (there is unit root) at 1%, 5% 10% significance level, respectively.

Table A3: Robustness

	Dependent variable is log of foreign exchange reserve and GDP ratio										
Specification	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Exc China Case 10	Exc Ch & Jp Case 11
ln(Import/GDP)	0.351**			0.544***	0.398***	0.531***	0.501***		0.500***	0.548***	0.470***
	(0.161)			(0.140)	(0.137)	(0.146)	(0.143)		(0.161)	(0.137)	(0.116)
ln(Res vol)	0.186***			0.198***	0.164***	0.161***	0.135***	0.207***	0.208***	0.205***	
	(0.0515)			(0.042)	(0.053)	(0.027)	(0.026)	(0.039)	(0.0374)	(0.039)	0.211*** (0.040)
Expgrowth			-0.0004	-0.0009	-0.0003	-0.0007	-0.0004	-0.0009	-0.0006	-0.0005	-0.0006
			(0.0006)	(0.0006)	(0.0005)	(0.0007)	(0.0008)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
ln(NEER vol)		-0.099***	-0.065***	-0.049**	-0.033**	-0.052***	-0.039*	-0.046**	-0.044**	-0.044**	-0.043**
		(0.027)	(0.017)	(0.019)	(0.015)	(0.016)	(0.019)	(0.020)	(0.019)	(0.020)	(0.021)
ln(Inf vol)				0.032	0.019	-0.010	0.005	0.007	0.011	0.011	0.012
				(0.021)	(0.015)	(0.017)	(0.020)	(0.022)	(0.022)	(0.022)	(0.023)
Finopen	0.029			0.059*	0.019						
	(0.026)			(0.029)	(0.030)						
ln(m2/GDP)	0.190				0.243*						
	(0.131)				(0.143)						
ln(fdi/GDP)			0.104***		0.037*						
			(0.035)		(0.021)						
GDPgrowth		0.004 (0.006)									
Depositrate						0.005 (0.003)					
Lendingrate							-0.005 (0.006)				
ln(Trade/GDP)								0.514*** (0.128)			
ln(Exp/GDP)									0.089 (0.124)		
Constant	-5.149***	-1.671***	-1.244***	-5.405***	-4.516***	-4.536***	-3.945***	-5.919***	-5.503***	-5.490***	-5.666***
	(1.110)	(0.039)	(0.127)	(0.844)	(1.114)	(0.547)	(0.549)	(0.824)	(0.773)	(0.793)	(0.785)
Observations	723	925	762	700	650	621	595	793	793	770	748
# of countries	39	43	40	38	37	34	33	40	40	39	38
R-squared	0.409	0.056	0.163	0.496	0.516	0.541	0.565	0.426	0.482	0.482	0.455

Notes: Robust standard errors clustered by countries are given in parentheses. *, **, and *** indicate significance at the 10%; 5%; and 1% levels, respectively.

Table A4: Some Relevant Facts ang Figures (Figures in billion US $)

Year	GDP		Reserves					Export		Import		
	World	Asia	World	Asia	Growth (world)	Growth (Asia)	% of total (Asia)	World	Asia	World	Asia	res months of import (Asia)
1998	31540	7685	1930	826	3.46%	7.26%	42.79037	6679	1635	6848	1442	6.88
1999	32737	8551	1999	977	3.58%	18.25%	48.85105	6923	1762	7151	1554	7.54
2000	33831	9287	2125	1099	6.27%	12.56%	51.74129	7684	2114	8006	1881	7.01
2001	33615	8716	2232	1204	5.06%	9.51%	53.93095	7513	2007	7799	1838	7.86
2002	34911	8891	2626	1439	17.61%	19.48%	54.78814	7891	2165	8101	1946	8.87
2003	39147	9855	3272	1896	24.60%	31.81%	57.95772	9146	2550	9387	2277	10.00
2004	44118	11130	3961	2417	21.07%	27.46%	61.01423	11108	3235	11365	2887	10.04
2005	47780	12146	4524	2831	14.22%	17.15%	62.57848	12639	3845	12893	3376	10.06
2006	51780	13166	5529	3402	22.21%	20.17%	61.53332	14572	4525	14749	3926	10.40
2007	58355	15066	7125	4376	28.86%	28.62%	61.42006	16956	5321	17101	4612	11.39
2008	64124	17368	7776	4969	9.14%	13.56%	63.90618	19411	6264	19605	5525	10.79
2009	60809	17719	9046	5735	16.33%	15.40%	63.39209	15645	5116	15756	4652	14.79
2010	66596	20783	10132	6276	12.00%	9.44%	61.94153	18650	6553	18675	5885	12.80
2011	73854	23887	11498	7284	13.48%	16.07%	63.35428	22012	7852	22024	7173	12.19
2012	75488	25366	12366	7683	7.55%	5.47%	62.12786	22334	8232	22279	7592	12.14
2013	77607	25658	12715	8306	2.82%	8.11%	65.32453	22907	8448	22843	7775	12.82
2014	79709	26618	12588	8383	-1.00%	0.93%	66.59667	23258	8554	23341	7974	12.62
2015	75179	26265	11763	7743	-6.55%	-7.64%	65.82132	20622	7628	20753	7073	13.14
2016	76466	27441	11606	7408	-1.34%	-4.32%	63.83305	20232	7380	20354	6855	12.97
2017	81404	29419	12469	7785	7.44%	5.08%	62.43465	22270	8170	22401	7691	12.15
2018	86413	31604	12443	7740	-0.20%	-0.57%	62.20259	24414	8956	24629	8520	10.90
2019	87653	32239	13073	8060	5.06%	4.13%	61.65217	23919	8692	24288	8269	11.70
2020	84907	31702	14236	8652	8.90%	7.35%	60.77481	21418	7916	21710	7369	14.09
2021	96100	35400	14813	8952	4.06%	3.47%	60.43223	22158	8328	26983	7709	13.93

Source: Author's calculation based on World Development Indicators (World Bank)

Table A5: List of Asian Countries

Afghanistan	Iran, Islamic Rep.	Malaysia	Tajikistan
Armenia	Iraq	Maldives	Thailand
Azerbaijan	Israel	Mongolia	Timor-Leste
Bahrain	Japan	Myanmar	Turkey
Bangladesh	Jordan	Nepal	Turkmenistan
Bhutan	Kazakhstan	Oman	United Arab Emirates
Brunei Darussalam	Kyrgyz Republic	Pakistan	Uzbekistan
Cambodia	Korea, Rep.	Philippines	Vietnam
China	Kuwait	Qatar	West Bank and Gaza
Georgia	Lao PDR	Saudi Arabia	Yemen, Rep.
Hong Kong SAR, China	Korea, Dem. People's Rep.	Syrian Arab Republic	
India	Lebanon	Singapore	
Indonesia	Macao SAR, China	Sri Lanka	