Research Article

International Reserve Accumulation in Emerging Market Economies: The Role of Global Factors

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Abstract: This study examines whether global liquidity and risk matter for the international reserve accumulation in 46 countries characterized as Emerging Market Economies (EMEs) by the International Monetary Fund (IMF) from 2000 to 2019. By using panel data techniques and a broad dataset based on Lane and Milesi-Ferretti's (2022) External Wealth of Nations II database and various data sources for global factors, this paper first shows that global liquidity is positively associated with international reserve holdings. Second, in consideration of greater reliance on financial factors, it tests the joint effects of capital inflows, capital controls, and global factors and provides evidence that countries tend to accumulate larger international reserves as (i) external liabilities grow in periods of abundant global liquidity and (ii) capital control policy tightens in periods of high confidence loss. Finally, this work questions which type of capital inflow has a greater impact on international reserve holdings and whether the drivers of reserve accumulation evolved over the sample period. The results suggest that countries respond to FDI inflows more than other inflows, and the impacts of global liquidity and risk become more apparent between 2008 and 2019.

Keywords: International reserves, global liquidity, global risk, emerging market economies
Jel Codes: *F32, F36, F38, F62*

Yükselen Piyasa Ekonomilerinde Uluslararası Rezerv Birikimi: Küresel Faktörlerin Rolü

Öz: Bu çalışma, küresel likidite ve riskin yükselen piyasa ekonomilerinin rezerv birikiminde önemli bir etken olup olmadığını International Monetary Fund (IMF) tarafından yükselen piyasa ekonomisi olarak nitelendirilen 46 ülke ve 2000-2019 dönemi için incelemektedir. Panel veri teknikleri ve Lane & Milesi-Ferretti'ye (2022) ait External Wealth of Nations II veri tabanına ve küresel faktörler için çeşitli veri kaynaklarına dayanan geniş bir veriseti kullanılarak yapılan bu çalışma, ilk olarak küresel likidite ve uluslararası rezervler arasında pozitif yönlü bir ilişki olduğunu göstermektedir. İkinci olarak finansal faktörlerin artan etkisini dikkate alarak sermaye girişleri, sermaye kontrolleri ve küresel faktörlerin ortak etkilerini test etmekte ve ülkelerin (i) küresel likiditenin bol olduğu dönemlerde dış yükümlülükler arttıkça ve (ii) yüksek güven kaybının olduğu dönemlerde sermaye kontrol politikası sıkılaştıkça daha fazla rezerv biriktirme eğiliminde olduklarına dair kanıtlar sunmaktadır. Son olarak bu çalışma, hangi tür sermaye girişinin uluslararası rezervler üzerinde daha etkili olduğunu ve rezerv birikiminin belirleyenlerinin örneklem dönemi içinde değişip değişmediğini sorgulamaktadır. Sonuçlar, ülkelerin doğrudan yabancı yatırım girişlerine (DYY) diğer sermaye giriş türlerinden daha fazla tepki verdiğini ve küresel likidite ve riskin etkilerinin 2008-2019 döneminde daha belirgin olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Uluslararası rezervler, küresel likidite, küresel risk, yükselen piyasa ekonomileri
Jel Kodları: *F32, F36, F38, F62*

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1. Introduction

Since the late 1990s, EMEs have become major actors in the global economy by sustaining high growth rates and middle-income levels, extending market access, and serving as production and trading centers. Over the last two decades, their share in global exports has tripled and their share in global imports doubled (International Monetary Fund, 2024a). Many of them have built large current account surpluses through the trade of manufactured goods. In addition, they increased their role in international financial markets as recipients and sources of global capital because of increasing financial liberalization. Along with this collective influence on global markets, their contribution to global GDP has more than doubled. Duttagupta & Pazarbasioglu (2021) note that institutional transformation and remarkable progress in implementing sound macroeconomic policies in the early 2000s have served as a catalyst and today, the largest emerging economies account for one-third of global GDP.

Against this backdrop, EMEs have accumulated massive international reserves since the mid-1990s. As noted by Jeanne (2007), the large reserve holdings of EMEs can be safeguarding tools against current and capital account shocks and increased volatility of capital flows arising from high financial globalization and/or an unintended result of large current account surpluses. These attributes have tempted researchers to discuss the motivations of EMEs for holding large levels of international reserves. In the existing literature, there are two established views on the motivations: the precautionary motive is that reserves play a buffering role against sudden shocks, and the mercantilist motive is that reserves stand for a policy to gain export competitiveness. The evolving nature of the global economy keeps this discussion alive and adds new reasons to hold reserves. One of them is considering global and financial factors.

Global factors are the byproducts of the global financial environment changing through the developments in macro-financial activities. The most common factor is global liquidity referring to the ease of financing in global financial markets. In a broader sense, it implies the size of cross-border financial flows guided by global banks and non-bank financial institutions (Goldberg, 2023). Therefore, global liquidity is associated with the changes in the monetary policy of advanced countries, essentially of the US, and investors' risk sentiments. As widely accepted in the literature, trends in global liquidity can be traced by the evolution of the policy rate of the US. When the US interest rate increases, global liquidity declines and vice versa. Global liquidity evolved over two decades and implied different phases resulting from major changes in the macro-financial environment. In the early 2000s, it rapidly increased after the fall of policy rates in the US and other advanced economies, then it slowly narrowed. In the aftermath of the Global Financial Crisis (GFC) in 2008, it climbed up with the low policy rates.

The abundance or shortage in global liquidity has some implications for financial stability, especially in EMEs, because global conditions are external to them, and the global environment affects financial flows to/from them. Also, increases in global liquidity are generally related to asset price booms and a rapid rise in credit growth. For instance, in times of abundance, investors tend to take excessive risks and threaten the financial stability of domestic markets. In case of shortages, the financial markets tend to be turbulent due to the fall in the risk appetite of investors or a slowdown in financial inflows. This may make financial markets shallow by disturbing the functioning of the markets.

Figure 1 shows the evolution of global liquidity measured by the shadow rate of Wu-Xia, the international reserve holdings of EMEs, and the world.[1] It seems that the global monetary easing phases correspond to the rise of international reserves, particularly in the post-GFC period. In EMEs, the reserve holdings increased by more than 10% annually until 2012. Then, the acceleration in reserves slowed down and stabilized with moderate

[1] Wu-Xia is the shadow rate of the US that performs better than the federal funds rate to show the signals of conventional and unconventional monetary stances. See Wu & Xia (2016) for details.

growth rates in recent years. In the post-crisis era, reserve holdings did not ever reach their pre-crisis extraordinary growth rates that peaked at around 30-40%. However, the recent trend is still a signal that EMEs continue to lie their back to safe assets to maintain macro-financial stability.

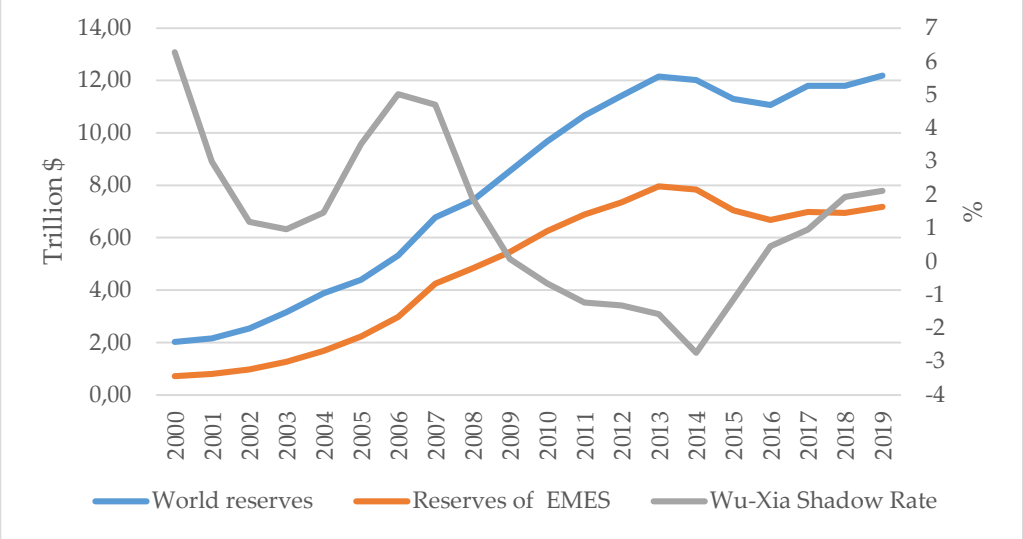

Figure 1. Global Liquidity and International Reserves of EMEs. (**Source:** The International Liquidity Statistics of the IMF, IFS database, 2024 and the Federal Reserve Bank of Atlanta, 2024.)

The recent and active discussion on the association between global liquidity and reserves can be extended by relating it to capital flows. As widely accepted in the literature, global financial conditions are crucial push factors driving capital inflows. Milesi-Ferretti & Tille (2011) and Forbes & Warnock (2012) document that the abundance or shortage of global liquidity and changes in risk appetite or investors' sentiments are the new push variables that significantly determine the volume of capital flows, particularly the periods of surges, sudden stops, and retrenchments.[2] From this perspective, an increase in global liquidity and risk appetite can lead to inflow surges or a decline in global liquidity, or a rise in global risk can cause sudden stops. Miranda-Agrippino & Rey (2015) and Rey (2015) argue that aggregate risk aversion determines the Global Financial Cycle referring to the interconnections between cross-border flows and asset prices. Rey (2015) points out the importance of the center economies' monetary policies as a leading factor of the global financial system and capital flows. We can now connect reserve accumulation and the global financial environment. If EMEs tend to accumulate international reserves as a buffer against sudden stops, their reserve demand will increase in abundant liquidity periods to absorb them (Patel & Cavallino, 2019; Han et al., 2023). The reserve accumulation can also be an inevitable policy reaction of EME policymakers to avoid macro-financial instability resulting from massive liquidity due to an increase in capital inflows. These mechanisms are financial byproducts of the self-insurance motives of EMEs and allow us to add global and financial factors to the drivers of reserve accumulation.

We can further expand this debate through the link between gross inflows and outflows. The size of reserves can be related to counties' gross liability and asset positions. That is, high reserve holdings of EMEs can be an optimal response to massive capital inflows. As argued by Jeanne (2016), when capital flows start to drain with a sudden stop, assuming that there is no friction in the financial markets, private agents should respond

[2]For a detailed literature survey focusing on the determinants of capital flows in EMEs, see Koepke (2019).

by capital outflows (increase in foreign assets of domestic residents).[3] However, in many emerging markets the private sector is constrained by some frictions caused by undeveloped financial markets, insufficient knowledge of investing abroad, and some legal limitations (Han et al., 2023). These obstacles force the public sector to undertake this role. When the domestic private sector fails to increase foreign assets, the public sector increases the size of reserve assets to buffer the economy against sudden stops (Jeanne, 2016; Han et al., 2023). This liquidity management process indicates that EMEs' reserve accumulation can be globally and financially driven, especially in the post-GFC era. In this era, the abundance of global liquidity may lead to expansion in financial inflows to EMEs and force EMEs' governments to increase their reserve holdings for insurance against the probability of a sudden stop. Furthermore, if the private sector is insufficient to rebalance or offset excessive inflows with private outflows, the public sector can do this by increasing reserve holdings.

Against this background, we examine the role of global factors in the reserve accumulation of EMEs between 2000 and 2019 by using appropriate panel data models. Our empirical analysis begins with the identification of drivers of reserve accumulation. We include global liquidity and risk indicators as global factors (variables of interest); external liability and asset positions of countries (gross inflows and outflows) as financial factors and the remaining as traditional factors that are based on previous research. We estimate a model that associates these variables with the international reserves to GDP ratio and extend it by testing whether capital inflows and capital control policies alter the link between international reserves and global factors. By doing the last, we quantify the joint effects of global factors, capital inflows, and capital control policies and allow for several transmission mechanisms. Finally, we control which type of capital inflow affects reserve accumulation more and test whether there is an evolution in the drivers of reserve holdings over time by splitting the sample period into two subperiods: 2000-2007 and 2008-2019. The results show that global liquidity robustly associates with reserve accumulation suggesting increase in global liquidity promotes hoarding reserves. However, the global risk alone does not affect the size of reserves. We also find that the external liability position of a country has a transmitting role in reserve holdings when it interacts with global liquidity. Similarly, capital controls and global risk jointly drive reserve accumulation suggesting higher restrictions on capital flows in periods of high confidence loss leads to an increase in reserve holdings. Finally, the results suggest that reserve accumulation of EMEs responds more to the FDI inflows, and the impacts of global factors become more apparent between 2008 and 2019.

We contribute to the literature in three dimensions. First, we add to the literature on drivers of reserve accumulation by considering the role of global liquidity and risk and providing evidence that reserve holdings are globally liquidity-driven, and this effect becomes more pronounced after the GFC. Second, we attach importance to the joint effects of global factors, capital inflows, and capital controls. We show that abundant global liquidity and higher external liability position (gross inflows) jointly increase reserve accumulation, and the use of tighter capital controls in the more volatile global financial environment makes EMEs prudent and increases their reserve holdings. Third, we extend the literature by highlighting the evolution of drivers of reserve accumulation in support of the results indicating that the global and financial factors are more apparent in the post-crisis period.

We organize the paper as follows: Section 1 gives an overview of international reserve accumulation in EMEs over the last three decades. Section 2 describes the main motives for accumulating reserves and reviews the existing literature. Section 3 explains the data and methodology used in the empirical analysis. Section 4 reports the findings of

[3] Forbes & Warnock (2012) and Broner et al. (2013) show that gross capital inflows and outflows tend to move together. Jeanne (2016) underlines that there was an apparent coincidence of large declines in capital inflows, even sudden stops and retrenchment in capital outflows during the Global Financial Cycle.

empirical estimations. The last section concludes by assessing the results and discussing policy implications.

2. Overview of International Reserve Accumulation in EMEs

We have witnessed a remarkable increase in reserve holdings of EMEs over three decades. Behind this unprecedented accumulation, there is a pronounced motive which fed from self-insurance. As EMEs get involved in international financial markets via cross-border capital flows, they become more exposed to global disturbances. Large and volatile capital inflows make EMEs more vulnerable to the global financial environment and ultimately force them to find self-insurance mechanisms to maintain macro-financial stability. Additionally, sudden stops make them more concerned about vulnerabilities in the domestic environment such as sharp decreases in output and investment, contractions in credit facilities, and even banking crises. To buffer such instabilities and eliminate the huge damages, EMEs have been more precautionary by hoarding sizeable reserves since the late 1990s, particularly, in the aftermath of the Asian Crisis, 1997-1998.

Given the motives above, the trend of reserve accumulation between 2000 and 2020 can be traced in Figure 2. As seen, the increase in the size of international reserves has been widespread among main country groups over two decades, but there are significant differences in the shares of groups. After 2005, emerging and developing countries have the largest share of the accumulation of reserves. They hold more than half of the world's reserves. Among them, emerging and developing Asia has the largest share accounting for more than 35% of the world's total. Also, China and Hong Kong's holdings are remarkably high in this region, accounting for almost 80% of the region's total. Sub-Saharan Africa has the lowest share accumulating only 1-2% of the world's reserves. In this picture, the global financial crisis in 2008 stands as a turning point that brings volatilities back as argued by Aizenman et al. (2015). The GFC led policymakers to change their monetary stances and increased the concerns about macro-financial stability. Although the origin of the GFC is the US and the advanced economies suffered the most, EMEs were highly influenced by the GFC due to the sizeable foreign exposure and sudden stops. In general, as they became increasingly integrated into international financial markets, they recognized that they were getting closer to external shocks. Since the well-known self-insurance device in a financially liberalized world was hoarding reserves along with past experiences, EMEs accumulated reserves to guard themselves after the GFC. As seen in Figure 2, almost all country groups continued to hold high-size reserves in the post-crisis era. However, there is a deceleration in the reserve holdings between 2013 and 2017.

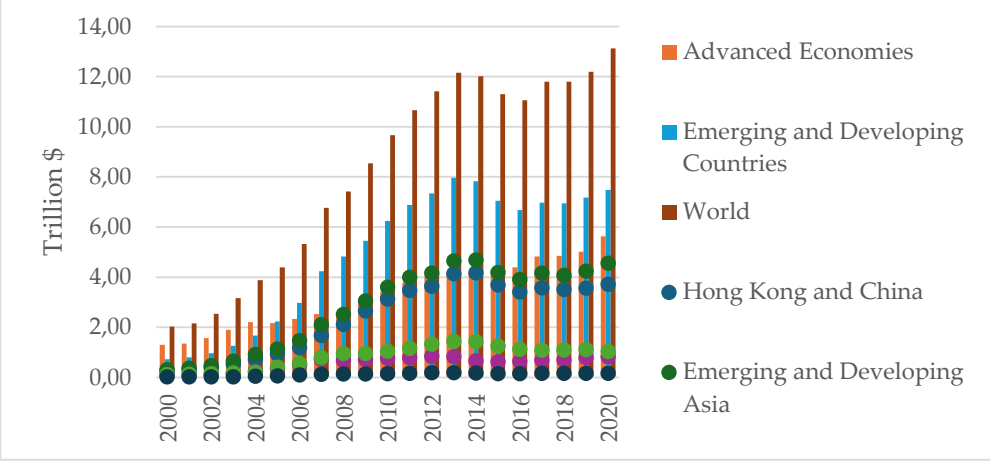

Figure 2. The Size of International Reserves: Breakdown by Country Groups
(**Source:** The International Liquidity Statistics of the IMF, IFS database, 2024.)

The prudential use of international reserves in EMEs is also a part of the discussions on reserve adequacy. The reserve adequacy framework compares countries' reserve positions with some macroeconomic aggregates. To assess reserve adequacy, the policy papers of the International Monetary Fund (IMF) in 2013 and 2015 propose an analytical framework including the measurement of reserve adequacy and guarding countries against several risks and vulnerabilities. Traditionally, there are three measures of reserve adequacy: import cover, the ratio of reserves to short-term external debt, and the ratio of reserves to broad money (M2). The import cover shows the number of months that a country sustains imports. The benchmark of the import cover is assumed to be 3 months. The second measure considers the potential demand for repayments of short-term borrowing in foreign currency. The benchmark is the Guidotti-Greenspan rule that suggests a 100% cover. The last measure is related to the potential demand for foreign assets and domestic sources. The benchmark is assumed to be 20% (Arslan & Cantú, 2019).

Figures below show the reserve adequacy measures of some selected emerging market economies in the years 2004, 2009, 2014, and 2019. Figure 3 is for the import cover. Figures 4 and 5 depict the ratio of reserves to broad money and short-term debt, respectively. As seen, the adequacy measures in many countries lie above the benchmarks over the past two decades. China again seems to be a significant reserve holder by having the highest import cover and reserves to short-term external debt ratio. For the ratio of reserves to broad money, The Russian Federation and Hungary have substantial levels of reserves when compared to their domestic resources. When periods are considered, there is not a uniform change and thus the heterogeneity among countries remains. The given reserve adequacy levels signal that the EMEs' demand for international reserves may be highly prudent, but they can only stand as a starting point for making an assessment. To complete this, we need an empirical analysis that pays attention to drivers of reserve accumulation including several country characteristics and global and financial factors forcing EMEs to hoard large reserves.

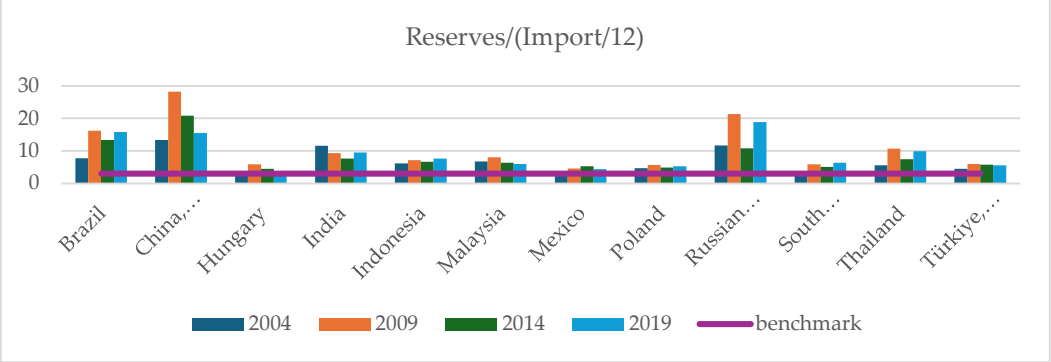

Figure 3. Import Cover, Benchmark: 3 Months. (**Source:** The World Bank, WDI dataset, 2024.)

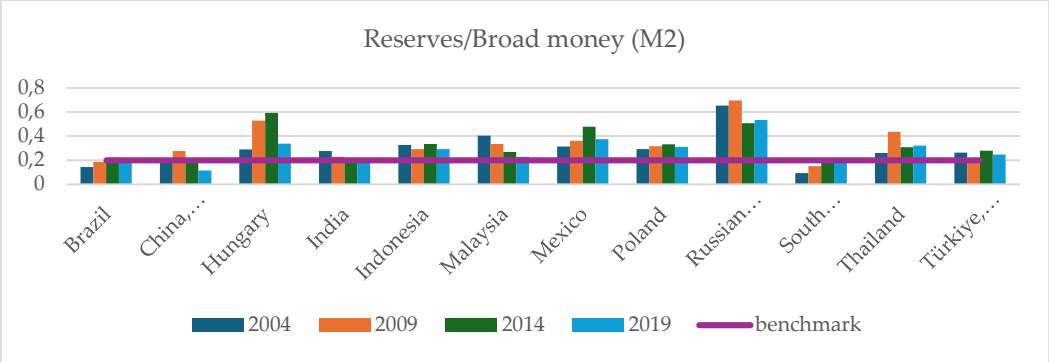

Figure 4. The Ratio of Reserves to Broad Money, Benchmark: 100%
(**Source:** The World Bank, WDI dataset, 2024)

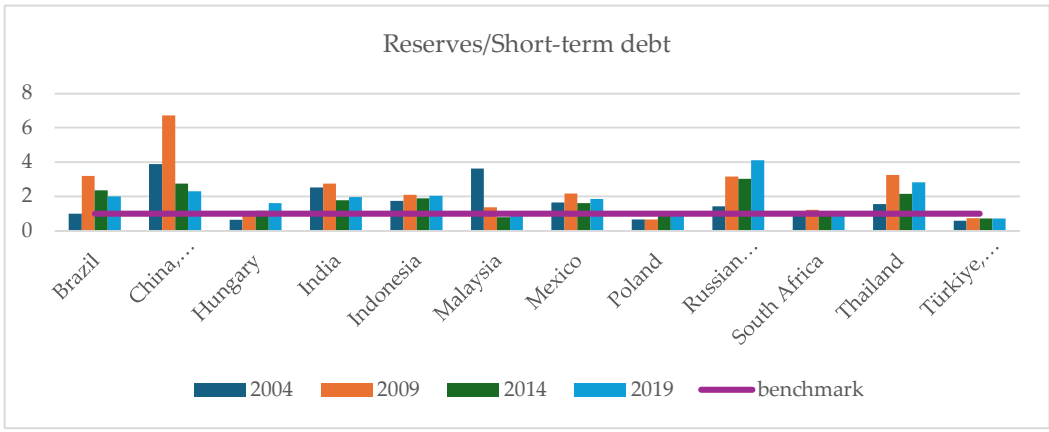

Figure 5. The Ratio of Reserves to Short-Term Debt, Benchmark: 20%
(**Source:** The World Bank, WDI dataset, 2024.)

3. Related Literature

Identifying the motives of EMEs to accumulate high-size international reserves has been increasingly examined by several empirical studies since the mid-1990s. However, the theoretical considerations can be carried to the pioneering work of Heller (1966) which deals with determining the optimal level of reserve holdings. Heller (1966) identifies the optimum level of reserve holdings as the amount that minimizes the total cost of adjusting for and financing external imbalances. Thus, the propensity to import, the cost of holding reserves, and imbalances in the balance of payments can be listed as the main determinants of the optimal level of international reserves. Another contribution to the theoretical setting is from Frenkel & Jovanovic (1981) which explains that reserves have an accommodating role in tackling the volatility of external transactions and holding an optimal level of reserves can play a buffer-stock role. Heller (1966) and Frenkel & Jovanovic (1981) prioritize the active role of trade shocks in holding international reserves and launch the importance of precautionary motives. However, recent theoretical studies have paid more attention to financial shocks as well. Jeanne & Rancière (2011) argue that financial turbulences have become an increasing concern in EMEs, and international reserves advance their function as an insurance tool against a sudden stop.

The second well-known alternative to precautionary adjustment is the modern mercantilist view. As argued by Dooley et al. (2004) and Aizenman & Lee (2007), this view concerns export competitiveness. The developmental processes of China and East Asia are the most famous examples of the mercantilist purpose of holding large reserves. In these countries, reserve accumulation is used to maintain an undervalued exchange rate. The undervalued exchange rate slows down the appreciation of the currency and

promotes export growth. From a developmental perspective, this mechanism is in line with the industrial strategy of these countries and supports export-led growth. By following such a mechanism, these countries also influenced the high current account deficit countries like the US. Additionally, Dooley et al. (2004) state that the mercantilist motive complements the intention to ensure inflows of foreign investment by playing a role as collateral.

Over the last two decades, several studies (Aizenman & Marion, 2003; Aizenman & Lee, 2007; Jeanne, 2007; Cheung & Ito, 2009; Obstfeld et al. 2010; Dominguez 2010, Aizenman & Sun, 2012) have examined the weights of precautionary and mercantilist motivations in accumulating international reserves. These studies provide evidence that supports both views. In general, they document that neither of these factors fully picture the acceleration of reserve holdings of EMEs in the early 2000s. There are also a few studies that analyze the reserve accumulation process and reserve policies of some countries such as Aizenman et al. (2007) and Ra (2007) for South Korea; Sehgal & Sharma (2008) for India; Ozyildirim & Yaman (2005), Nebiye & Yamak (2014), Kilci (2019, 2021) for Türkiye; Zheng & Yi (2007), Schröder (2017), Wang & Hueng (2019) for China. These studies cannot reach a consensus on the importance of alternative motives of reserve accumulation and support the cross-country evidence.

Meanwhile, the GFC remarkably changed the direction of the literature. Scholars began to discuss the impact of the GFC and the role of financial factors in accumulating reserves. The starting point of this active discussion is the increased financial integration of EMEs throughout the 2000s. In that period, most of the EMEs lowered the restrictions on capital flows and attracted substantial levels of capital inflows. This trend was also supported by the maturing of the East Asian countries in export-led growth strategy. Naturally, the mercantilist intentions slowed down in the late 2000s. However, the frequency of financial crises increased in EMEs and ultimately, the GFC hit these economies with sudden stops. In general, the macro-financial instabilities reappeared. All these developments led to the rise of financial considerations in building international reserves (Cheung & Ito, 2009). In the post-crisis period, the precautionary motive reminded itself again. This time around, global and financial factors urged it. They diverted the questioning of the latest studies to whether there is a change in the determinants of international reserve holdings over time. Among these recent studies, Aizenman et al. (2015) investigated the new patterns of holding reserves. They showed the increasing importance of financial factors and the role of supplemental policy devices such as macro-prudential regulations, capital flow management policies, special swap lines, and sovereign wealth funds (SWF). Aizenman et al. (2015) confirmed that EMEs have undergone some structural changes after the GFC and reserve accumulation became more sensitive to sudden stops, banking crises, and external exposure than ever before.[4]

It is noteworthy that the GFC and the resulting abundance in global liquidity after the quantitative easing policy of the FED changed the policy reactions of EMEs. Several countries added new prudential measures to their policy toolkit to protect themselves from global disturbances or implemented capital controls to mitigate the impacts of large and volatile capital inflows. For example, Brazil implemented a tax policy on capital inflows to curb capital flow volatility in 2009-2014 and Türkiye relied on macro-prudential policies considering the financial instabilities after the GFC. Although there is no consensus on the best devices to achieve macro-financial stability, macro-prudential and capital flow management policies find increasing approval from EME policymakers. The policy choices are also affected by the link between gross inflows and outflows. Jeanne & Sandri (2023) note that gross inflows can be rebalanced with gross outflows. When foreign residents increase their purchases of EME assets, domestic residents raise their holdings of foreign assets and vice versa. This is a way to smooth the volatility of capital inflow

[4] A strand of literature has been focusing on the stabilizing effects of reserves. For details see Bussière et al. (2015), Blanchard et al. (2015), Ghosh et al. (2016), and Avdjiev et al. (2022).

volatility. However, in recent years, to further curb capital flow volatility, EME policymakers have implemented capital controls and foreign exchange interventions. Whether these countries employ such policies or not is related to the extent of the rebalancing mechanism between inflows and outflows. If countries cannot offset inflow surges via outflows, the reserve accumulation can become a necessary and even an inevitable device to manage liquidity or absorb the excess liquidity, or countries can enjoy using capital flow management policies to mitigate the fluctuations in capital flows. Jeanne & Sandri (2023) have shown that the public sector actively buys reserve assets when gross inflows increase and sells them when gross inflows decline.

More recently, Han et al. (2023) have revisited the importance of the rebalancing mechanism between private and public flows in reserve accumulation. They built a model for accumulating reserves by associating the level of reserves with the large capital inflows in the presence of financial frictions. In their model, two mechanisms rebalance large capital inflows: private sector investment abroad, that is capital outflow, and public sector flows which are simply accumulating international reserves. Their model is based on the view that when global factors drive the gross inflows to EMEs, domestic residents find it optimal to invest abroad to smooth consumption. However, in the presence of financial frictions like restrictions and regulations on financial flows or in financial markets, the private sector cannot increase foreign asset purchases, and the public sector gets involved by holding reserves. They empirically test theoretical propositions by using a two-step estimation procedure by taking VIX and the US real exchange rate as a global (push) factor driving capital flows and using globally driven capital flows as a determinant of reserve holdings. Their empirical findings reveal that EMEs tend to hold more reserves in response to globally driven capital inflows when financial frictions are controlled by tighter controls on gross capital outflows. To move beyond Han et al. (2023), this study diversifies the global factors as global liquidity and risk and incorporates the transmission roles of financial factors and capital control measures into the analysis.

Overall, the existing literature emphasizes that the precautionary motive is still alive as foreign capital excessively surges to EMEs. To improve our understanding of the role of global and financial factors in the reserve accumulation behavior of EMEs, we proceed with the empirical analysis in the next sections.

4. Data and Methodology

Against this background, this part explains the data and the empirical method used in assessing the role of global factors on the reserve holdings of 46 EMEs.[5] The data covers the period between 2000 and 2019 and is estimated by panel data techniques.[6]

In our empirical strategy, the first step is to identify the potential determinants of reserve holding. We combine traditional determinants that were massively used in several empirical studies (Aizenman & Marion, 2003; Aizenman & Lee; 2007, Obstfeld et al. 2010; Aizenman & Sun, 2012) and the more recently discussed ones in the literature (Aizenman et al., 2015; Cabezas & De Gregorio, 2019, Han et al., 2023). Our dependent variable is the international reserves to GDP ratio. We scale international reserves as a percentage of GDP for comparing countries with different sizes. The traditional explanatory variables are the propensity of import measured by imports as a percentage of GDP, real income per capita, volatility of exports, volatility of exchange rate, short-term debt level as a percentage of total external debt, gross savings as a percentage of GDP, and exchange rate regime. The volatility of exports and exchange rates are calculated by standard deviations from a rolling window process.[7] The set of newly discussed explanatory variables

[5] Countries in the sample are selected through data availability based on the list of middle-income countries classified by the World Bank. The list of countries is given in the Appendix A1.

[6] The data sources are given in Appendix A5.

[7] To compute the volatility, we apply a commonly referred method of Neumann et al. (2009) based on calculating the standard deviation of a variable over a rolling window on an annual basis.

involves global drivers like global liquidity, global risk, and financial drivers proxied by the financial liability or asset position of a country as an indicator of the volume of gross inflows or outflows. Also, we add the measure of financial openness to control the impact of capital account openness on reserve holdings.

In this analysis, the main variables of interest are global liquidity and global risk. We measure global liquidity by the Wu-Xia shadow rate which considers the US monetary policy at "zero lower bond". The shadow rate reflects the FED's additional and unconventional monetary policies pursued after 2009.[8] The increasing levels of the Wu-Xia denote a decline in or tightening of global liquidity. We proxy the global risk by the CBOE Volatility Index (VIX) which measures the implied volatility of the S&P 500 Index. The higher levels of VIX reflect the increase in uncertainty and fear in the financial markets or a loss in confidence. Among financial variables, the external liability position of a country shows the share of all external liabilities (FDI, portfolio, and other investment liabilities) in GDP, and indicates the level of gross inflows and external financing capacity of a country. We also expect that this variable can capture the capital inflow-driven international reserves. In a similar vein, we allow for the external asset position of a country in our estimations to test the impact of gross outflows (purchases of foreign assets by domestic residents) due to its rebalancing role when inflows surge. Finally, financial openness is measured by the Chinn-Ito index and capital control indicators of Fernández et al. (2016). All data descriptions, sources, and descriptive statistics are given in the Appendix.

In the second step of our empirical strategy, we build the empirical models, decide on different specifications, and choose appropriate estimation methods. The following equation is the benchmark,

$$IR_{it} = \propto + \beta_k Global_{t-1} + \varphi_l \mathrm{Z}_{it-1} + \delta_i + \epsilon_{it} \quad (1)$$

where IR_{it} is the share of international reserves in GDP for country i at year t. $Global_t$ denotes global drivers of international reserves (global liquidity and risk measures) which are the variables of interest. Z_{it} is the vector of potential drivers including traditional and financial factors. δ_i shows the country-fixed effects and ϵ_{it} is the error term.

The following equation is the extension of the benchmark model that adds interaction terms,

$$IR_{it} = \propto + \beta_k Global_{t-1} + \theta_m Global_{it-1} \times \mathrm{T}_{it-1} + \varphi_l \mathrm{Z}_{it-1} + \delta_i + \epsilon_{it} \quad (2)$$

In Equation (2), $Global_{t-1} \times \mathrm{T}_{it-1}$ denotes the interaction term calculated by multiplying global drivers by the external liability position or the capital control measure. This term shows the joint effects of global factors, capital inflows, and capital control policy. By adding an interaction term, we control whether the impacts of global factors change when financial variables interact with them. Our main intuition is that there may be a transmission channel in the existing relationship between global factors and reserve holdings. For instance, the external liability position may transmit the potential impulse of a global factor to the international reserves and lead to a dampening or amplifying impact on reserve holdings. From the perspective of the policy variable, the response of international reserves may be different when global variables are in conjunction with capital control policies. This view can become more plausible when we consider the EME policymakers' increased tendency to implement capital control policies to stabilize the macro-financial environment since the GFC. Thus, capital control policy can be seen as a transmission device as well, it may serve as an amplifier or insulator.

[8] For more details, see Wu & Xia (2016) and Wu & Zhang (2019).

Our empirical analysis has another step enriching our framework with two additional sets of estimations. In the first set, we question which type of external liability position (FDI, portfolio, and other liabilities) contributes more to the accumulation of reserves. In the second, we consider the evolution of determinants over the sample period. To show how the effects of different types of variables evolve, we split the whole period into two sub-periods: 2000-2007 and 2008-2019. We expect that the impacts of global and financial variables will become more pronounced from 2008 to 2009. To test this evolution, we exercise estimations by using the same models for two subperiods.

The models given above are all estimated by using the Fixed Effects (FE) regression procedure. To control autocorrelation and heteroskedasticity, we rely on Driscoll & Kraay (1998) standard errors and to overcome the endogeneity, we include all explanatory variables with their one-period lags.

5. Empirical Results

In this section, we present the empirical results and interpret the findings. Table 1 summarizes the results of various estimations based on the benchmark model. Columns (a) and (b) show only the impacts of traditional variables. In Column (b), we replace the financial openness measure (C_I) with capital control on outflows as a proxy of capital account openness.[9] The remaining columns present the results including traditional, global, and financial variables with different specifications. As seen in Columns (a) and (b), the propensity of import (IM_GDP), and the development level of a country (GDPPC) are positively related to the international reserve holdings. As countries import more and become richer, they are likely to hold more international reserves. Export volatility (VOL_EXP) is negatively associated with reserves, indicating that countries that are more exposed to export volatility tend to demand fewer reserves. The exchange rate volatility (VOL_EXC) is another significant driver of reserve holdings. As the exchange rate fluctuations increase, countries demand more reserves. As argued by Aizenman et al. (2015), currency stress can lead EMEs to hoard increasing levels of reserves against large variations in the exchange rate and even currency shocks. Among traditional variables, the short-term external debt and the exchange rate regime (EXC_REG) are found to be insignificant. The reserve holdings do not respond to short-term debt and whether the regime is a peg or float. In column (a), the Chinn -Ito index significantly and negatively impacts reserve holdings, indicating that less financially open countries tend to hold more reserves. When the Chinn-Ito index is replaced with the capital control measure (KAO) in Column (b) which has an opposite interpretation (increasing levels indicate higher restrictions), we find that tighter controls increase the size of reserves. The results for the Chinn-Ito index and capital control measure are consistent, both support the significant role of capital account restrictions on reserves.

Columns (c) to (g) present the results of different specifications including global and financial drivers.[10] As seen in Column (c), the global liquidity measure (R_US) has a significant negative association with reserve holdings. Tightening in the US monetary policy and hence the decline in global liquidity reduces the level of reserves. EMEs respond to abundant liquidity by accumulating more reserves. This result remarks that international reserves are globally driven and supports the recent argument on EMEs that accumulating reserves can be optimal to absorb excess liquidity documented by Jeanne & Sandri (2023) and Han et al. (2023). The global risk factor (VIX) is insignificant. Countries

[9]Fernández et al. (2016) dataset has three capital control measures: overall capital controls (average of inflow and outflow controls), capital controls on inflows, and capital controls on outflows. To consider the role of balancing private inflows with public outflows (i.e. reserve accumulation) in a financial market with frictions, we decide to use capital controls on outflows in the spirit of Han et al. (2023). We attach more importance to the frictions that prevent domestic residents from purchasing foreign assets and show them through the restrictions on capital outflows.

[10] In Columns (c) to (g), we continue with the Chinn-Ito index as a financial openness measure. We exclude the results including the capital control measure (KAO) due to presentation limitations. We confirm that in each specification that includes the KAO, we find a positive and significant coefficient revealing that an increase in restrictions leads to an increase in the size of reserves.

do not respond to increasing levels of confidence loss. As a financial factor, the external liability position (EXT_LIAB) has a significant positive impact on demand for reserves. As foreigners increase their domestic asset purchases (i.e. an increase in gross inflows), EMEs tend to expand their reserve holdings. Since the results show that EMEs accumulate reserves when capital inflows are high and sell when they recede, we can conclude that reserves are also capital inflow-driven.[11] We will use this evidence in further estimations by linking global factors and capital inflows to better understand the effects of loose or tight global conditions on reserve accumulation.

Column (d) reports the results when we control the robustness of the global liquidity measure. In this specification, instead of the shadow rate of the US, we use the spread between LIBOR (London Inter Bank Offered Rate) and OIS (Overnight Swap Index). This new measure (LIB_OIS) is a summary indicator of distress in money markets (FED, 2009) and higher levels reflect the liquidity freezes. Given that the 3-month LIBOR is the benchmark rate for a broad set of financial contracts in money markets and the OIS is an indicator of investor expectations of effective federal funds rate over the term of the swap which can be seen as free of credit risk, the spread between them may indicate the global liquidity conditions by considering the liquidity and credit risks in the money markets.

As documented by Ingves (2014), the LIBOR-OIS spread rose remarkably during the GFC leading to a liquidity freeze in the markets. As seen in Column (d), the LIBOR-OIS spread has a significant negative impact on reserve holdings revealing that increases in distress that tighten the global liquidity reduces the level of reserves of EMEs. This provides evidence of the robustness of global liquidity measures previously used. Distinctly, VIX becomes significantly positive in this specification, indicating that the higher the confidence loss, the more the tendency to hoard international reserves. However, when the measure of global volatility is replaced with financial instability (FSI) and financial uncertainty (FIU) indices, we find that these measures are insignificant once again (see Columns from (e) and (f))[12]. We can conclude that although global liquidity has a robustly significant impact on reserve holdings, the impact of global risk is imprecise. In the last column, we report the impact of the external asset position (EXT_ASSET) of a country on reserve holdings. EXT_LIAB and EXT_ASSET variables are highly correlated, and hence we estimate separately and find that a rise in gross asset position significantly promotes reserve accumulation. This result suggests that more investment abroad by residents makes the governments more prudent and pushes them to accumulate reserves. When the magnitudes of coefficients between EXT_LIAB and EXT_ASSET are compared, we see that the impact of the external liability position is higher than the external asset position. EME governments respond to gross inflows more than gross outflows.

[11] This result seems to be in line with the observation of Jeanne & Sandri (2023) pointing out that the public sector tolerates capital inflow volatilities by accumulating international reserves when gross inflows increase and reducing reserves when inflows decrease.

[12] FSI is a financial stress indicator developed by joining several financial market indicators such as asset valuation, interest rates, credit and yield spreads, level of funding, etc. FIU is an indicator of financial uncertainty developed by Jurado et al. (2015) which is based on rich financial market data and provides information about time-varying uncertainty. FSI data can be obtained from https://www.financialresearch.gov/financial-stress-index/ and FIU data from https://www.sydneyludvigson.com/macro-and-financial-uncertainty-indexes.

Table 1. The Results of the Benchmark Model

VARIABLES	(a)	(b)	(c)	(d)	(e)	(f)	(g)
IM_GDP	0.222***	0.187***	0.200***	0.138***	0.201***	0.200***	0.225***
	(0.058)	(0.051)	(0.043)	(0.039)	(0.048)	(0.044)	(0.0546)
GDPPC	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VOL_EXP	-0.153*	-0.169**	-0.149**	-0.137*	-0.150**	-0.150**	-0.182**
	(0.086)	(0.080)	(0.068)	(0.068)	(0.068)	(0.069)	(0.090)
VOL_EXC	0.129***	0.146***	0.088***	0.094***	0.086***	0.087***	0.129***
	(0.040)	(0.040)	(0.028)	(0.0246)	(0.028)	(0.027)	(0.043)
S_EXT_DEBT	0.058	0.084	0.067	0.035	0.066	0.066	0.073
	(0.059)	(0.057)	(0.055)	(0.064)	(0.056)	(0.056)	(0.058)
G_SAV	0.248***	0.230***	0.297***	0.277***	0.294***	0.294***	0.280***
	(0.067)	(0.063)	(0.059)	(0.056)	(0.060)	(0.059)	(0.065)
EXC_REG	0.824	1.426	1.256	-1.276	1.130	1.137	1.756
	(2.481)	(2.533)	(2.343)	(2.365)	(2.386)	(2.363)	(2.307)
C_I	-3.790*		-4.374**	-5.285***	-4.019***	-4.020**	-3.448
	(2.031)		(1.636)	(1.683)	(1.747)	(1.736)	(2.157)
KAO		6.315**					
		(2.448)					
R_US			-0.456**		-0.491***	-0.494***	-0.525***
			(0.145)		(0.172)	(0.181)	(0.118)
LIB_OIS				-2.207***			
				(0.672)			
VIX			0.050	0.191*			0.015
			(0.079)	(0.063)			(0.082)
FSI					0.002		
					(0.037)		
FIU						0.309	
						(1.583)	
EXT_LIAB			0.069***	0.081***	0.067***	0.067***	
			(0.011)	(0.011)	(0.010)	(0.009)	
EXT_ASSET							0.034**
							(0.014)
CONS	-3.466	-9.032	-8.128	-0.460	-6.405	-6.676	-6.266
	(9.578)	(10.648)	(8.275)	(8.075)	(8.954)	(8.049)	(8.130)
N	661	661	661	629	661	661	661
# OF COUNTRIES	46	46	46	46	46	46	46
R^2	0.258	0.264	0.330	0.326	0.308	0.305	0.287

Notes: Standard deviations are given in parentheses. *, **, *** represent the 10%, 5% and 1% significance. All the explanatory variables are used with one-year lags to avoid endogeneity.

In the next stage of the empirical analysis, we test the impacts of interaction variables referring to a transmission mechanism related to the global variables. In these estimations, we add two interaction terms: (i) R_US*EXT_LIAB which denotes the joint effect of global liquidity and external liability position, and (ii) VIX*EXT_LIAB which denotes the joint effect of global risk and external liability position. We report the results in Table 2. In Columns (a) and (b) the interaction terms are R_US*EXT_LIAB, and VIX*EXT_LIAB respectively. As seen in Column (a), the interaction term is significantly negative providing evidence that global liquidity and capital inflows jointly affect the level of reserves. When inflows surge with an increase in global liquidity, the reserve holdings expand in EMEs. However, in Column (b), the interaction term is insignificant, indicating that no transmission mechanism jointly affects reserve holdings related to global risk and inflow surges.

Table 2. Estimation Results for Interaction Terms- The Transmission of Global Liquidity and Risk via Capital Inflows

VARIABLES	(a)	(b)
IM_GDP	0.200***	0.193***
	(0.036)	(0.045)
GDPPC	0.001***	0.001***
	(0.000)	(0.000)
VOL_EXP	-0.103	-0.149**
	(0.066)	(0.070)
VOL_EXC	0.069**	0.092***
	(0.028)	(0.029)
S_EXT_DEBT	0.081	0.068
	(0.059)	(0.055)
G_SAV	0.286***	0.293***
	(0.061)	(0.060)
EXC_REG	1.322	1.243
	(2.179)	(2.315)
C_I	-4.645***	-4.028**
	(1.615)	(1.612)
R_US	0.240	-0.520***
	(0.252)	(0.143)
VIX	0.176**	0.075
	(0.076)	(0.063)
EXT_LIAB	0.074***	0.078***
	(0.009)	(0.014)
R_US*EXT_LIAB	-0.009***	
	(0.002)	
VIX*EXT_LIAB		-0.000
		(0.000)
CONS	-11.543	-7.918
	(7.768)	(8.290)
N	661	661
# OF COUNTRIES	46	46
R^2	0.355	0.331

Notes: Standard deviations are given in parentheses. *, **, *** represent the 10%, 5% and 1% significance. All the explanatory variables are used with one-year lags to avoid endogeneity.

We proceed by adding interaction terms related to the capital control policy. The results are presented in Table 3. In these estimations, the interaction term is the multiplication of global liquidity and risk measures with three types of capital control measures. The first indicator shows the overall capital controls (KA), the second refers to the capital controls only on inflows (KAI) and the third indicates the capital controls only on outflows (KAO). The first three columns show the results for the interaction term R_US*KA/KAI/KAO respectively and the last three columns report the VIX*KA/KAI/KAO respectively. As seen, the interaction terms indicating the combined effect of global liquidity and capital controls are insignificant. This suggests that reserve holdings do not respond to the joint change in capital control and global liquidity. For instance, tightening the restrictions in a higher abundance of global liquidity does not affect the size of reserves. However, in Columns (d) to (f), we see that interaction terms are significantly positive. An increase in global risk combined with higher restrictions increases the reserve holdings. This suggests that the capital control policy may become a supplementary device to accumulate reserves under an unconfident financial environment. More restrictive capital account policies, such as the ones previously implemented during the GFC, may lead countries to hold more reserves in turbulent times.

Table 3. Estimation Results for Interaction Terms- The Transmission of Global Liquidity and Risk via Capital Control Policies

VARIABLES	(a) Global liquidity	(b) Global liquidity	(c) Global liquidity	(d) Global risk	(e) Global risk	(f) Global risk
IM_GDP	0.178***	0.185***	0.175***	0.180***	0.187***	0.177***
	(0.045)	(0.045)	(0.045)	(0.044)	(0.045)	(0.044)
GDPPC	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VOL_EXP	-0.150**	-0.146**	-0.159**	-0.163**	-0.160**	-0.167**
	(0.068)	(0.070)	(0.066)	(0.067)	(0.068)	(0.065)
VOL_EXC	0.096***	0.090***	0.102***	0.096***	0.091***	0.102***
	(0.029)	(0.028)	(0.028)	(0.028)	(0.027)	(0.026)
S_EXT_DEBT	0.068	0.059	0.080	0.088*	0.081	0.093*
	(0.057)	(0.058)	(0.057)	(0.050)	(0.051)	(0.051)
G_SAV	0.278***	0.284***	0.278***	0.278***	0.284***	0.279***
	(0.055)	(0.055)	(0.057)	(0.052)	(0.052)	(0.054)
EXC_REG	1.308	0.951	1.467	1.559	1.135	1.697
	(2.514)	(2.533)	(2.410)	(2.563)	(2.532)	(2.484)
R_US	-0.391***	-0.387***	-0.421***	-0.377***	-0.406***	-0.369***
	(0.128)	(0.137)	(0.124)	(0.120)	(0.118)	(0.120)
VIX	0.052	0.053	0.049	-0.011	-0.009	0.000
	(0.078)	(0.079)	(0.078)	(0.068)	(0.070)	(0.066)
EXT_LIAB	0.065***	0.067***	0.064***	0.066***	0.067***	0.065***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
KA	3.638			0.316		
	(3.013)			(3.135)		
KAI		0.556			-2.876	
		(2.191)			(2.309)	
KAO			3.737*			1.203
			(2.040)			(2.215)
R_US*KA/VIX*KA	-0.209			0.194***		
	(0.172)			(0.064)		
R_US*KAI/VIX*KAI		-0.285			0.192***	
		(0.171)			(0.065)	
R_US*KAO/VIX*KAO			-0.095			0.155***
			(0.160)			(0.051)
CONS	-10.452	-8.137	-11.176	-11.033	-8.405	-11.915
	(9.793)	(9.459)	(9.275)	(9.959)	(9.535)	(9.487)
N	661	661	661	661	661	661
# OF COUNTRIES	46	46	46	46	46	46
R^2	0.324	0.323	0.326	0.331	0.329	0.332

Notes: Standard deviations are given in parentheses. *, **, *** represent the 10%, 5% and 1% significance. All the explanatory variables are used with one-year lags to avoid endogeneity.

We finalize the empirical estimations by adding two more extensions. First, we disentangle the external liability position and form variables such as FDI_LIAB, PORT_LIAB, and OI_LIAB representing FDI, portfolio, and other investment liability positions respectively to provide evidence on which type of capital inflow dominantly affects the size of reserves. Second, we form sub-periods to better understand the evolution drivers of reserve accumulation and estimate them separately.

As shown in Table 4, the gross external position in FDI and portfolio investment positively and significantly affects the level of reserves. EMEs tend to hold more reserves in response to increases in foreign asset purchases in the form of FDI and portfolio investment. However, the gross external position in other investments does not affect the reserve holdings. From that point, we can conclude that the increases in cross-border banking transactions which dominate the other investment flows do not significantly alter the reserves while the portfolio and the FDI are highly influential. When we compare FDI and portfolio liabilities, we find that the impact of FDI liabilities is higher than that of portfolio liabilities. This result is consistent with Han et al. (2023) providing evidence that FDI inflows are more significant on reserve accumulation.[13]

[13] For similar arguments on the link between FDI inflows and reserve accumulation, please see Dooley et al. (2004), Wang (2019) and Matsumoto (2022).

Table 4. Estimation Results-Disentangling the External Liability Position

VARIABLES	(a)	(b)	(c)	(d)	(e)	(f)
IM_GDP	0.161***	0.134***	0.225***	0.207***	0.234***	0.203***
	(0.036)	(0.038)	(0.053)	(0.049)	(0.051)	(0.048)
GDPPC	0.000***	0.000***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VOL_EXP	-0.128*	-0.141**	-0.191**	-0.199**	-0.169**	-0.184**
	(0.065)	(0.063)	(0.092)	(0.087)	(0.083)	(0.080)
VOL_EXC	0.071***	0.085***	0.128***	0.138***	0.125***	0.143***
	(0.023)	(0.022)	(0.044)	(0.043)	(0.040)	(0.041)
S_EXT_DEBT	0.090	0.106*	0.079	0.094*	0.055	0.080
	(0.056)	(0.052)	(0.056)	(0.054)	(0.065)	(0.059)
G_SAV	0.297***	0.278***	0.256***	0.247***	0.281***	0.259***
	(0.059)	(0.055)	(0.063)	(0.058)	(0.069)	(0.063)
EXC_REG	1.200	1.449	1.722	2.102	1.803	2.304
	(2.336)	(2.464)	(2.323)	(2.370)	(2.252)	(2.303)
C_I	-4.623***		-1.606		-3.828	
	(1.542)		(1.899)		(2.404)	
KAO		3.561*		3.797		5.278**
		(2.066)		(2.573)		(2.533)
R_US	-0.425***	-0.445***	-0.531***	-0.513***	-0.509***	-0.503***
	(0.153)	(0.149)	(0.119)	(0.125)	(0.128)	(0.126)
VIX	0.064	0.053	0.036	0.038	0.001	0.001
	(0.067)	(0.061)	(0.083)	(0.080)	(0.086)	(0.081)
FDI_LIAB	0.181***	0.172***				
	(0.019)	(0.019)				
PORT_LIAB			0.134***	0.127***		
			(0.036)	(0.036)		
OI_LIAB					0.037	0.025
					(0.026)	(0.021)
CONS	-5.653	-8.780	-7.536	-10.821	-6.956	-11.324
	(8.176)	(9.347)	(8.075)	(9.175)	(8.398)	(9.526)
N	661	661	661	661	661	661
# OF COUNTRIES	46	46	46	46	46	46
R^2	0.371	0.366	0.294	0.297	0.281	0.283

Notes: Standard deviations are given in parentheses. *, **, *** represent the 10%, 5% and 1% significance. All the explanatory variables are used with one-year lags to avoid endogeneity.

To examine whether the drives of reserve accumulation evolve, we split the whole period into two sub-periods: 2000-2007 and 2008-2019. The sub-sample results are given in Table 5. As seen, there are major differences between sub-periods. Between 2000 and 2007 (see Columns (a) and (b)), the propensity to import, GDP per capita, short-term external debt, gross savings, and exchange rate regime are the main drivers of the reserve holdings. Given all these variables represent traditional factors, EMEs tend to accumulate reserves conventionally to avoid balance of payment problems. The insignificance of volatilities in exports and exchange rates among traditional factors also shows that EMEs are more concerned about the risk of insolvency instead of the fluctuations in exports and the currency in the pre-crisis period. In particular, the positive impact of short-term external debt is a signal of EMEs' resistance to be adequate in reserves to avoid external financing problems. The most striking finding in Columns (a) and (b) is that none of the global and financial variables are significant. This emphasizes the importance of traditional factors once more. It seems that reserve holdings are not globally driven, and financial considerations are not on the agenda of EMEs in 2000-2007. Both measures of capital account openness seem to be insignificant, making EMEs' reserve accumulation unbound from financial openness in the pre-crisis era.

The results for the period 2008-2009 given in columns (c) and (d) highlight the evolution of drivers of reserve accumulation by making the global factors more apparent. Global liquidity, global volatility, and external liability position become highly influential on reserve holdings in the post-crisis period. An increase in global liquidity, a decrease in investor confidence, and thus the increase in gross inflows increase the reserve holdings

of EMEs. Finally, the capital control measure is positively significant (See Column (d)) revealing that EMEs enjoy accumulating reserves as the capital controls tighten.

Table 5. Estimation Results: Sub-Periods

VARIABLES	(a) 2000-2007	(b) 2000-2007	(c) 2008-2019	(d) 2008-2019
IM_GDP	0.146***	0.144***	0.152*	0.130***
	(0.046)	(0.045)	(0.075)	(0.058)
GDPPC	0.000***	0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
VOL_EXP	-0.031	-0.035	-0.248**	-0.249**
	(0.032)	(0.029)	(0.096)	(0.095)
VOL_EXC	0.014	0.012	0.064	0.085
	(0.019)	(0.020)	(0.062)	(0.071)
S_EXT_DEBT	0.181***	0.185***	-0.195**	-0.180**
	(0.028)	(0.035)	(0.091)	(0.077)
G_SAV	0.263***	0.245	0.317***	0.307***
	(0.087)	(0.069)	(0.083)	(0.079)
EXC_REG	3.265**	3.232**	1.652	2.000
	(1.241)	(1.253)	(2.311)	(2.350)
C_I	-0.161		-4.770	
	(1.071)		(3.194)	
KAO		2.134		4.958*
		(2.084)		(2.722)
R_US	0.371	0.353	-0.724***	-0.687***
	(0.284)	(0.273)	(0.259)	(0.237)
VIX	-0.076	-0.076	0.114***	0.095***
	(0.099)	(0.097)	(0.042)	(0.036)
EXT_LIAB	0.018	0.016	0.102***	0.095***
	(0.021)	(0.021)	(0.008)	(0.009)
CONS	-12.246	-12.874	0.920	-3.672
	(7.553)	(8.306)	(7.625)	(9.505)
N	241	241	420	420
# OF COUNTRIES	46	46	46	46
R^2	0.444	0.446	0.257	0.252

Notes: Standard deviations are given in parentheses. *, **, *** represent the 10%, 5% and 1% significance. All the explanatory variables are used with one-year lags to avoid endogeneity.

6. Conclusions

In this paper, we put forward that global factors play an essential role in reserve accumulation. Based on annual data covering 2000-2019 and 46 EMEs, we examine the impacts of global liquidity and risk in a broad set of drivers of reserve holdings. By separating global and financial factors from traditional factors, we use a chance to trace the evolution of determinants of reserves over three decades. To better understand the link between global factors and capital flows in determining the size of reserves, we also consider the potential transmission mechanisms by interacting the global liquidity and risk measures with external liability positions and capital control policies. Furthermore, we compare the impacts of FDI, portfolio, and other investment inflows on reserve holdings and analyze the evolution of determinants of international reserves by estimating the models in two subperiods: 2000-2007 and 2008-2019.

The results reveal that global liquidity has a robust positive effect on international reserves. EMEs tend to increase their reserve holdings when global liquidity is abundant. However, the impact of global risk is imprecise. The findings on interaction variables that control the joint effects of global factors, capital inflows, and capital controls imply two pieces of evidence: (i) the joint effect of the external liability position and global liquidity is significantly positive indicating that EMEs can absorb excess liquidity by accumulating more reserves under inflow surges, (ii) the joint effect of capital controls and global risk is significantly positive suggesting that EMEs can guard against global volatility by accumulating more reserves under more restrictive capital account policies. These results

attach importance to the transmission role of capital inflows and capital control policies. The comparison between the impacts of different types of capital inflows points out that FDI inflows outweigh portfolio flows while other investment flows do not affect reserve accumulation. Finally, the results of sub-period estimations suggest an evolution in the determinants of international reserves. In the pre-crisis period (2000-2007), the concern of EMEs is the traditional balance of payments problems, and thus traditional variables drive the reserve accumulation more. However, in the post-crisis period (2008-2009), both global liquidity and risk become significant, indicating the increasing importance of global factors. After the GFC, EMEs tend to accumulate more reserves in response to abundant liquidity, and a greater loss of confidence.

Overall, the results confirm that global and financial factors in reserve accumulation have become more of an issue in recent years and are no longer ignorable by policymakers. Since the reserve accumulation gradually moves away from the scope of traditional factors, policymakers need to keep a close watch on changes in the global financial environment. When inflows surge and liquidity is abundant, the public sector might use its balance sheet by accumulating reserves to absorb excess liquidity. This way becomes more crucial if the private sector cannot offset inflow surges via outflows. In this circumstance, policymakers should be aware of how private agents rebalance the gross inflows in a financial environment with frictions and whether there is a need to accumulate reserves when inflows increase and sell reserves when inflows decline. Also, they might find using capital controls appropriate as a supplementary when investors' confidence declines. So long as global and financial factors threaten macro-financial stability, EMEs will be more prudent and use reserve accumulation as a safeguarding device. Future research has a chance to improve our understanding of the link between global financial environment reserve accumulation by considering what extent EMEs offset gross inflows via outflows or reserves and how financial frictions affect liquidity management between the private and public sectors.

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Appendix

A1. Country Sample

Algeria, Argentina, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Georgia, Ghana, Guatemala, Hungary, India, Indonesia, Iran, Islamic Rep., Jamaica, Kazakhstan, Lebanon, Malaysia, Mauritius, Mexico, Moldova, Morocco, Nicaragua, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Tunisia, Türkiye, Ukraine, Uruguay, Uzbekistan, Viet Nam, Zambia

A2. Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min.	Max.
IR	920	18.885	15.295	0.615	106.869
IM_GDP	920	38.191	17.305	10.273	100.597
GDPPC	920	5108.590	3829.908	253.380	17563.200
VOL_EXP	874	9.388	7.957	0.183	78.889
VOL_EXC	874	10.315	15.530	0.000	169.597
S_EXT_DEBT	820	16.464	12.230	0.000	73.170
G_SAV	874	22.055	9.994	-19.903	57.414
EXC_REG	824	2.946	0.510	1.570	4.000
R_US	920	1.244	2.341	-2.736	6.283
VIX	920	19.486	6.149	11.090	32.696
LIBOR_OIS	874	0.223	0.453	-0.081	1.966
FSI	874	0.547	5.641	-4.539	21.014
FIU	874	0.905	0.194	0.635	1.456
C_I	920	0.507	0.339	0.000	1.000
KA	920	0.484	0.334	0.000	1.000
KAI	920	0.428	0.319	0.000	1.000
KAO	920	0.536	0.383	0.000	1.000
EXT_LIAB	920	129.470	379.112	3.139	3955.350
EXT_ASSET	920	83.866	419.124	1.476	4416.550
FDI_LIAB	920	65.300	265.148	0.360	2782.920
PORT_LIAB	920	20.352	44.510	0.000	599.204
OI_LIAB	920	39.870	66.220	-38.331	737.408

Note: Author's calculations.

A3. Correlation Matrix

	IR	IM_GDP	GDPPC	VOL_EXP	VOL_EXC	S_EXT_DEB	G_SAV	EXC_REG	R_US	VIX	LIBOR_OIS	FSI
IR	1.000											
IM_GDP	0.235	1.000										
GDPPC	0.148	-0.184	1.000									
VOL_EXP	0.005	-0.072	-0.138	1.000								
VOL_EXC	-0.184	-0.125	-0.026	0.561	1.000							
S_EXT_DEB	0.241	0.171	0.124	-0.054	0.025	1.000						
G_SAV	0.199	-0.072	-0.088	-0.023	-0.041	0.275	1.000					
EXC_REG	-0.002	-0.159	0.084	0.093	0.180	0.090	0.099	1.000				
R_US	-0.118	0.055	-0.251	0.034	0.067	0.021	0.021	0.082	1.000			
VIX	-0.057	0.016	-0.124	0.025	-0.051	0.005	-0.015	-0.023	-0.070	1.000		
LIBOR_OIS	-0.116	0.009	-0.139	0.042	-0.020	-0.008	-0.003	-0.013	0.248	0.483	1.000	
FSI	-0.032	0.067	-0.050	-0.037	-0.099	0.035	0.011	-0.008	0.084	0.768	0.513	1.000
FIU	0.004	0.036	0.022	-0.077	-0.098	-0.012	-0.007	-0.015	0.086	0.722	0.495	0.806
C_I	-0.050	0.166	0.134	-0.104	-0.094	-0.174	-0.251	-0.359	0.044	0.017	-0.009	0.028
KA	0.199	-0.086	-0.094	0.044	-0.047	0.172	0.363	0.247	-0.030	0.000	-0.012	-0.003
KAI	0.236	-0.078	-0.094	0.024	-0.058	0.191	0.401	0.255	-0.008	0.012	0.008	0.006
KAO	0.151	-0.085	-0.086	0.056	-0.033	0.141	0.295	0.214	-0.046	-0.011	-0.028	-0.010
EXT_LIAB	0.384	0.424	0.243	0.006	-0.060	-0.019	-0.381	-0.063	-0.082	-0.130	-0.099	-0.109
EXT_ASSET	0.234	0.176	0.238	0.110	0.024	-0.049	-0.180	0.127	-0.018	-0.084	-0.088	-0.071
FDI_LIAB	0.377	0.423	0.354	-0.072	-0.086	-0.021	-0.265	-0.139	-0.154	-0.156	-0.142	-0.113
PORT_LIAB	0.241	0.028	0.372	0.036	-0.012	-0.014	-0.202	0.218	-0.030	-0.143	-0.080	-0.116
OI_LIAB	0.236	0.401	-0.103	0.063	-0.029	-0.015	-0.360	-0.126	0.013	-0.011	0.002	-0.032

Note: Author's calculations

A4. Correlation Matrix-Continued

	FIU	C_I	KA	KAI	KAO	EXT_LIAB	EXT_ASSET	FDI_LIAB	PORT_LIAB	OI_LIAB
FIU	1.000									
C_I	0.019	1.000								
KA	0.000	-0.743	1.000							
KAI	0.004	-0.661	0.934	1.000						
KAO	-0.004	-0.738	0.957	0.790	1.000					
EXT_LIAB	0.004	0.286	-0.132	-0.155	-0.099	1.000				
EXT_ASSET	-0.040	0.080	-0.006	-0.024	0.008	0.386	1.000			
FDI_LIAB	0.024	0.295	-0.190	-0.197	-0.166	0.879	0.314	1.000		
PORT_LIAB	-0.018	0.041	0.199	0.166	0.205	0.563	0.540	0.441	1.000	
OI_LIAB	-0.005	0.249	-0.195	-0.213	-0.159	0.756	0.115	0.470	0.055	1.000

Note: Author's calculations

A5. Data Descriptions and Sources

Variable	Description	Source
IR	The share of reserves in GDP (%)	External Wealth of Nations Mark II database Lane and Milesi-Ferretti (2022)
IM_GDP	The share of imports in GDP	The World Bank WDI database
GDPPC	GDP per capita (constant $ in 2015)	The World Bank WDI database
VOL_EXP	Calculated by the standard deviations of Exports to GDP ratio over a rolling window	The World Bank WDI database
VOL_EXC	Calculated by the standard deviations of the nominal exchange rate over a rolling window	External Wealth of Nations Mark II database Lane and Milesi-Ferretti (2022)
S_EXT_DEBT	The share of short-term debt in total external debt (%)	The World Bank WDI database
G_SAV	The share of gross savings in GDP (%)	The World Bank WDI database
EXC_REG	Effective exchange rate regimes	Harms & Knaze (2021) dataset
R_US	Wu-Xia Shadow rate	Federal Reserve Bank of Atlanta
VIX	VIX (volatility implied by S&P 100)	CBOE Data
LIBOR_OIS	The spread between LIBOR and OIS	Bloomberg
FSI	Financial instability index	https://www.financialresearch.gov/financial-stress-index/
FIU	Financial uncertainty index	https://www.sydneyludvigson.com/macro-and-financial-uncertainty-indexes
C_I	Chinn-Ito index (a de jure measure of openness)	Chin-Ito database (2023)
KA	Overall capital control index	Fernández et al. (2016) database-updated
KAI	Capital controls on inflows	Fernández et al. (2016) database-updated
KAO	Capital controls on outflows	Fernández et al. (2016) database-updated
EXT_LIAB	The share of total financial liabilities to nonresidents in GDP (%)	External Wealth of Nations Mark II database Lane & Milesi-Ferretti (2022)
EXT_ASSET	The share of total financial claims on nonresidents in GDP (%)	External Wealth of Nations Mark II database Lane & Milesi-Ferretti (2022)
FDI_LIAB	The share of FDI liabilities to nonresidents in GDP (%)	External Wealth of Nations Mark II database Lane & Milesi-Ferretti (2022)
PORT_LIAB	The share of portfolio liabilities to nonresidents in GDP (%)	External Wealth of Nations Mark II database Lane & Milesi-Ferretti (2022)
OI_LIAB	The share of other investment liabilities to nonresidents in GDP (%)	External Wealth of Nations Mark II database Lane & Milesi-Ferretti (2022)

Note: Prepared by the author.