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Reserve Accumulation Dynamics: Analyzing the Impact of Exchange Rate Volatility and Export Growth

Introduction:

This paper is driven by the recent economic crisis in Sri Lanka, which inflicted substantial economic damage and incited months of political turmoil. The nation defaulted in May 2022, as its foreign reserves were nearly exhausted. With inflation soaring to almost 40%, Sri Lanka has struggled to secure essential imports, including fuel and medicine (Ondaatjie).

An article by the World Economic Forum called 'This Visual Breaks Down the Economic Crisis in Sri Lanka' identifies two primary factors contributing to the Sri Lankan crisis. Firstly, post-2009 civil war, the government pivoted its focus towards boosting domestic manufacturing and reliance on imports. Secondly, significant tax reductions implemented in 2019 adversely affected the accumulation of reserves.

Countries maintain foreign reserves for a variety of purposes, one of which is to guarantee that the value of their own currency fluctuates at a certain rate. As Sri Lanka has shown, having small foreign reserves may be extremely detrimental to a nation, particularly during economic downturns. Despite the growing importance of international reserves for global financial stability, there's a lack of clarity on what exactly drives countries to accumulate these reserves.

The paper 'Large Hoarding of International Reserves and the Emerging Global Economic Architecture' by Joshua Aizenman dives into relatively new phenomena that started happening at the beginning of the 21st century when developing nations, especially the emerging Asian market countries started hoarding international reserves. Countries that were stunned by the 1997 crisis wanted to hedge their growing financial integration through self-insurance by aggressively hoarding international reserves, but yet this interpretation fails to explain the growing reserves in emerging markets after 2000, therefore there might be other motives for such policies. The paper refers to the mercantilism approach that many emerging countries follow and how it leads to a type of prisoner dilemma where tariff wars and increases in reserves in emerging countries lead to a reduction in global trade and financial integration. The author doesn't give clear policy solutions to the problems proposed in the paper. First, the author suggests that China is an enabler in a region, and with its low sterilization costs, for countries such as Korea and Japan to compete with China in large markets such as the U.S., they are forced to keep hoarding international reserves to prevent further decline of their competitiveness.

To reiterate the main purpose of the paper, the author is trying to understand the trend of the accumulation of international reserves by countries in emerging markets and its economic implications. The author states the challenges with forming a unifying theory and empirical specification for mercantilist hoarding due to global changes and how new this phenomenon is. Nevertheless, the author uses interesting cases of "beggar-yourself" and "beggar-thy-neighbor" to illustrate the point of the "reserve hoarding war" that is happening in emerging markets. He uses two models of the symmetric case (beggar-yourself) and the asymmetric case (beggar-thy-neighbor) to illustrate that if all countries cooperatively decide not to aggressively hoard reserves, they might all benefit from stable international markets and less expenditure on managing large reserves (sterilization). If each country decides to act in its own self-interest and aggressively hoards reserves to gain a competitive edge, it can lead to imbalances, potential currency wars, and other negative repercussions in the international market. In conclusion, the paper states that there is a negative association between hoarding reserves and financial integration.

Theory

The proposed theory investigates why countries accumulate large reserves, focusing on two main purposes: aiding exporters by managing the exchange rate, thus making exports more competitive, and mitigating exchange rate volatility to maintain economic stability.

Export-led growth has been a cornerstone of economic strategy for many developing nations. By accumulating reserves, countries can influence their exchange rates to make exports cheaper on the world market, thus providing a competitive edge to domestic producers. This practice aligns with mercantilist theories, where the government uses policy tools to maintain a trade surplus.

Exchange rate stability is crucial for economic planning and international trade. High volatility in exchange rates can deter investment and disrupt economic stability. By holding significant reserves, a country can intervene in foreign exchange markets to stabilize its currency, thereby reducing the adverse effects of volatility on the economy.

Data Source

The paper will utilize time-series data on international reserves, export growth rates, and exchange rate volatility for the countries that are considered key economic partners for the United States. These countries include Canada, Mexico, China, Japan, and Germany.
The data will be sourced from FRED. The starting point for the data collection will be 2000 with a monthly frequency. The units are in USD for reserves and exports. The exchange rate data for

all countries is presented in direct terms from the US perspective, except for the data for China, which uses an indirect exchange rate. Data analysis will be conducted using baseline Python libraries, such as *Pandas, Numpy, and Matplotlib.* For the OLS regression I will utilize the *statsmodels* package.

Model

$$Reserves_t = β_0 + β_1 \cdot EX\_Growth_{t-1} + β_2 \cdot XR\_Volatility_{t-1} + ε_t$$

Where

$$XR\_Volatility_{t-1} = σ(XR_{t-12}, XR_{t-1})$$

- Reserves: Level of international reserves, measured in USD
- EX_Growth: Stands for export growth. reflecting the idea that reserve accumulation may be motivated by the need to support export-oriented growth. A positive value would suggest that an increase in export growth leads to higher reserve accumulation, which aligns with the mercantilist perspective that reserves help support exporters.
- XR_Volatility: represents exchange rate volatility, reflecting the idea that the volatility of exchange rates impacts reserve accumulation. This concept is quantified by measuring the standard deviation of monthly exchange rate movements over the past year and lagging it by one month. A positive value indicates that higher exchange rate volatility is associated with increased reserve hoarding, consistent with the view that countries accumulate reserves to manage volatility and stabilize the economy.

Data Visualization and Transformation

Doing some initial data visualization, I see from Figure 1 that the reserves are nonstationary. This might cause autocorrelation in regression since the model uses time-series data. Therefore, to avoid it, I applied differencing by calculating the percentage change in the reserves data and transforming it into a series of growth rates, which you can see visualized in Figure 2. I also applied a percentage change transformation for export growth, and for exchange rate volatility, I utilized a natural logarithm transformation. By converting volatility to a logarithmic scale, I reduce the impact of extreme values and non-linear relationships.
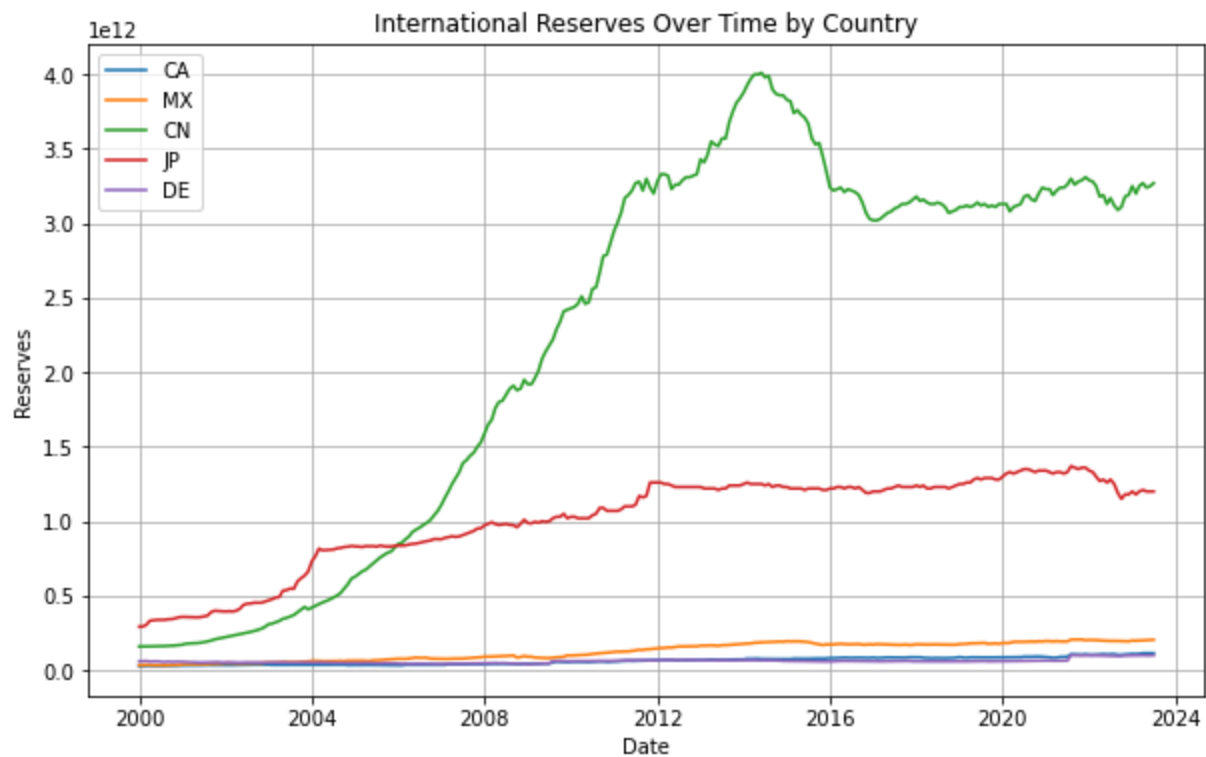
Figure 1. Unadjusted international reserves over time by country from 2000 to 2023 (represented in trillions of dollars).
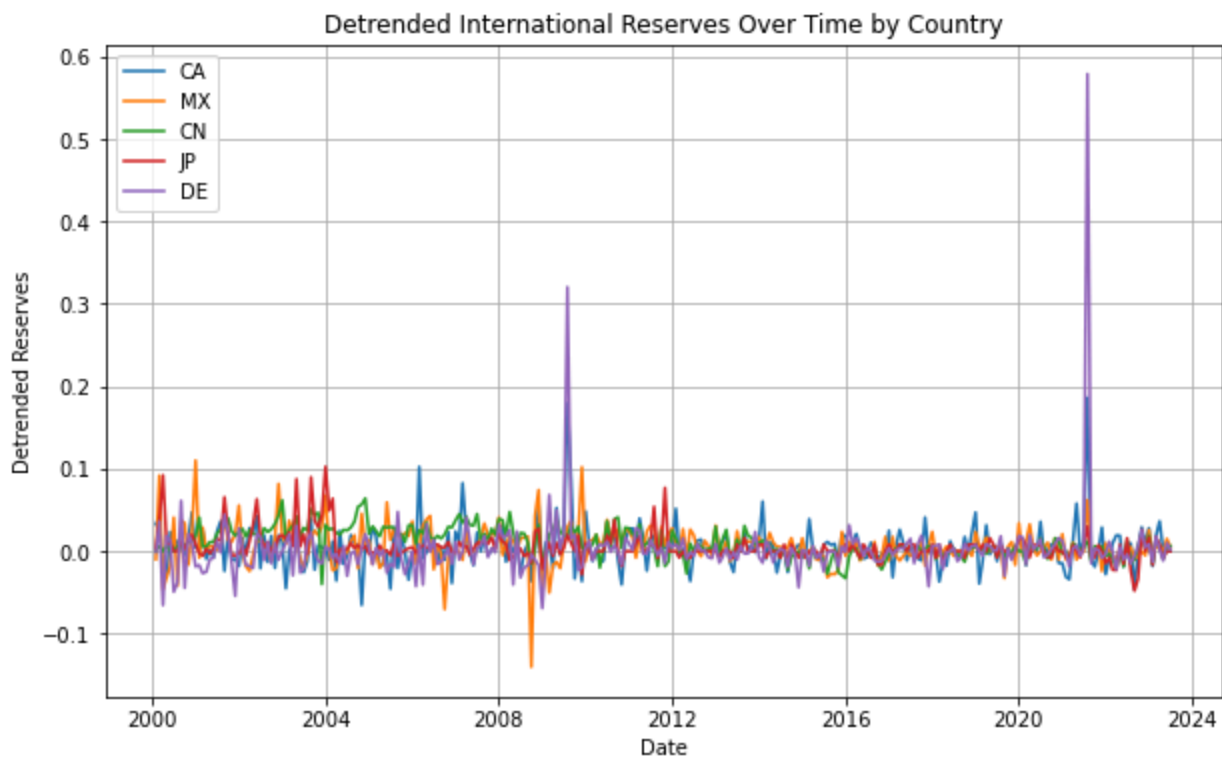
Figure 2. Percentage Change in International Reserves by Country from 2000 to 2023
(Detrended)

Regression

Running an OLS regression revealed that out of all five main US trading partners, only China has statistically significant results with a significant adjusted R^2 value of 0.217, or 21.7%. Durbin-Watson test result is 1.146, which shows no autocorrelation.

The coefficient of export growth is 0.008, meaning that there is a positive correlation between export growth and subsequent reserve accumulation. Although the p-value of 0.48 indicates that the result is not statistically significant,.

The coefficient for the natural logarithm of volatility is -0.0035, which is statistically significant. This indicates that as volatility increases by 1%, the reserve growth rate decreases by approximately 0.35%. For instance, with China's reserves at approximately 3.27 trillion USD in July 2023, a 0.35% reduction equates to about 11.45 billion USD. Therefore, each 1% rise in exchange rate volatility corresponds to a decrease of approximately 11.45 billion USD in China's current reserves. For further analysis, refer to Table 1.

Table1: OLS Regression Results for China

Dep. Variable:	CNRES	R-squared:	0.222
Model:	OLS	Adj. R-squared:	0.217
Method:	Least Squares	F-statistic:	38.31
Date:	Sat, 16 Dec 2023	Prob (F-statistic):	2.32e-15
Time:	15:57:37	Log-Likelihood:	740.85
No. Observations:	271	AIC:	-1476.
Df Residuals:	268	BIC:	-1465.
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0143	0.001	13.710	0.000	0.012	0.016
lag_ex_growth	0.0080	0.011	0.707	0.480	-0.014	0.030
ln_xr_volatility	-0.0035	0.000	-8.653	0.000	-0.004	-0.003

Omnibus:	6.476	Durbin-Watson:	1.146
Prob(Omnibus):	0.039	Jarque-Bera (JB):	10.131
Skew:	-0.021	Prob(JB):	0.00631
Kurtosis:	3.946	Cond. No.	31.0

References

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