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On the effectiveness of foreign exchange reserves during the 2021-22 U.S. monetary tightening cycle☆

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ABSTRACT

This paper examines whether the size of foreign exchange (FX) reserves explains cross-country differences in foreign currency depreciation realized over the 2021-22 Federal Reserve monetary policy tightening that led to a sharp appreciation of the US dollar. Across a broad sample of countries, we document that an additional 10 percentage points of FX reserves/GDP held *ex-ante* were associated with 1.5 to 2 percent less exchange rate depreciation against the US dollar and this buffer effect was larger among less financially developed economies. Effects were more pronounced for large-reserve countries that sold reserves to intervene than for large-reserve countries that did not intervene, supporting the presence of both balance sheet and intervention channels. Higher *ex-ante* policy rates were also associated with less depreciation especially among financially open economies. An analysis of daily currency movements following the June 2021 FOMC meeting corroborates the main results. These findings suggest that FX reserves may promote monetary policy independence in the presence of global spillovers.

1. Introduction

2022 marked an unprecedented acceleration of inflation that prompted the Federal Reserve to embark on its most aggressive monetary tightening cycle since at least 1983. With rising US interest rates and central bank balance sheet reduction under way, the US broad dollar appreciated by more than 15% from May 2021 to September 2022 (Fig. 1). Fig. 2 shows that foreign currency depreciations against the dollar over this period were large but highly uneven, and it remains unclear whether such differential exchange rate adjustments can be traced back to differences in country fundamentals and policy configurations.

This paper systematically examines the fundamental drivers of currency depreciation observed across countries during this episode, with a specific focus on the buffering role of foreign exchange (FX) reserves. To this end, we study the cross-section of currency depreciations that occurred between over May 2021-September 2022 as a result of the unexpected and sharp US dollar appreciation driven by aggressive US monetary policy. We test whether holding FX reserves mitigated depreciation pressures while controlling for cross-country differences in macroeconomic policies, economic fundamentals and factors other than US monetary policy that impacted the dollar over the same period.[1] This recent episode of US dollar appreciation presents a novel setting to test the effectiveness of FX reserves, as the extent of global market volatility was unexpected and also generated large and heterogeneous spillovers to the rest of the world.

We find that over the May 2021-September 2022 period, countries holding larger FX reserves *ex-ante*, i.e., in 2020, realized significantly

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[1] E.g., energy volatility triggered by Russia's invasion of Ukraine and commodity shocks linked to global supply chain disruptions.

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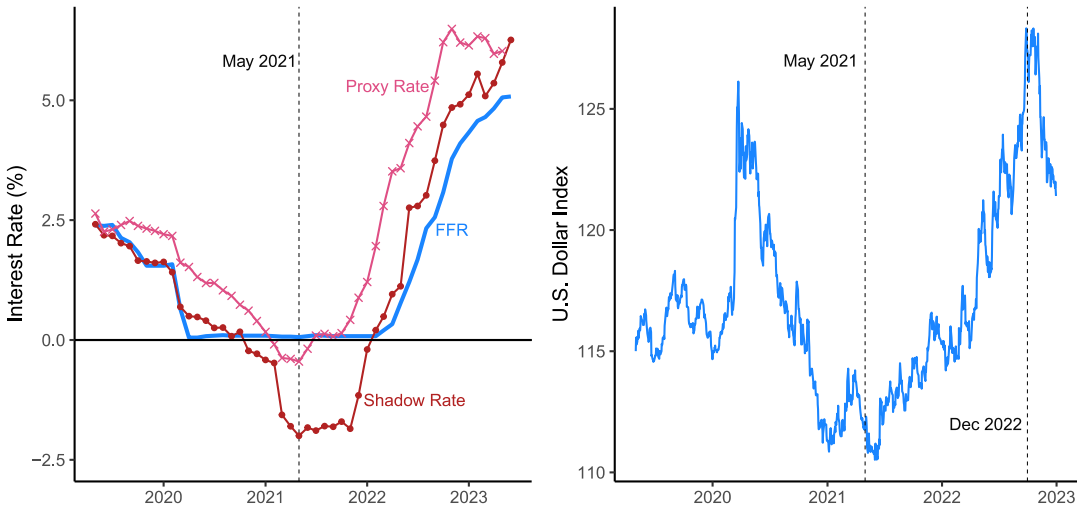

Fig. 1. US monetary tightening (left) and the nominal broad US dollar index (right). *Note:* The left panel traces the Fed Funds Rate (FFR), shadow rate Wu and Xia (2016), and proxy rate Choi et al. (2022) (monthly). The right panel plots the broad trade-weighted nominal dollar index (daily) with the region between the vertical lines indicating the episode of US dollar appreciation from May 2021 to September 2022.

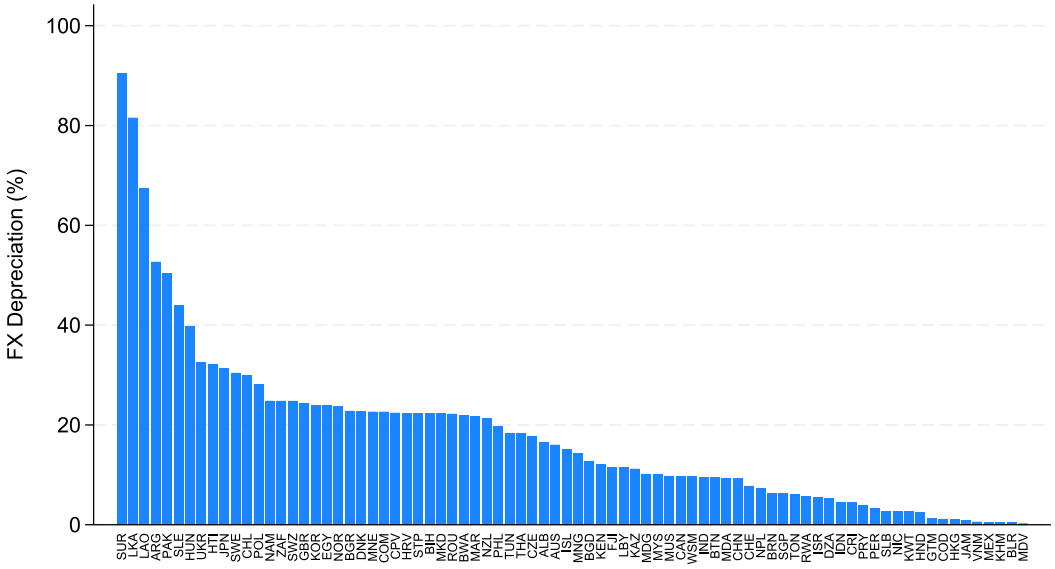

Fig. 2. Cross-country distribution of FX depreciation from May 2021 to September 2022. *Note:* FX depreciation on the y-axis corresponds to the percent depreciation against the US dollar.

less currency depreciation. An additional 10 percentage points of FX reserves/GDP held were associated with 1.5 to 2 percent less depreciation, and this effect was stronger among less financially developed economies. Effects were more pronounced for large-reserve countries that sold reserves to intervene than for large-reserve countries that did not intervene, lending support to the presence of both balance sheet and intervention channels. Countries with higher *ex-ante* policy rates also realized significantly less *ex-post* depreciation, and this association was stronger in more financially open countries.

We add to the literature on reserves accumulation by studying the consequences of holding reserves in the presence of international spillovers (Aizenman et al., 2023; Aizenman and Riera-Crichton, 2008; Dominguez et al., 2012; Kohlscheen, 2020).[2] Specifically, we treat the recent 2021-22-dollar appreciation episode as an external shock to the rest of the world that allows us to identify the buffering role of holding reserves on exchange rates. Closely related to our work are Aizenman et al. (2016); Eichengreen and Gupta (2015), and Ahmed et al. (2017) which test the buffering effects of reserves and fundamentals during the 2013 Taper Tantrum. However, these studies find mixed results on the role of FX reserves. Our analysis extends the literature by harnessing a large cross-section of countries to present new evidence on the buffering role of FX reserves and other fundamentals during one of the most aggressive episodes of US monetary tightening in recent decades.

2. Empirical framework

Our empirical strategy follows the cross-sectional regression analyses of Ahmed et al. (2017), Eichengreen and Gupta (2015), and Ahmed

[2] See also Aizenman and Lee (2007), Cabezas and De Gregorio (2019), Chinn et al. (2022).

Table 1
Dependent variable: FX change from May 2021 - Sep 2022 (%), depreciations only

	(1) Δp_i	(2) Δp_i	(3) Δp_i	(4) Δp_i	(5) Δp_i	(6) Δp_i
FX Reserves/GDP (2020)	− 0.1778***	− 0.1734**	− 0.4474**	− 0.3517***	− 1.0165***	− 0.1610**
	(0.0506)	(0.0757)	(0.1907)	(0.1221)	(0.2158)	(0.0746)
FX Reserves/GDP × Fin. Institutions			0.3400	0.2782**	1.4192***	
			(0.2066)	(0.1371)	(0.3939)	
Policy Rate (2020)		− 0.3481	− 0.8956	− 1.3140**	− 1.7930**	− 0.0622
		(0.4323)	(0.7172)	(0.5022)	(0.7418)	(0.3833)
Policy Rate × Fin. Openness			− 0.4343	− 0.4601	− 0.5298	
			(0.4778)	(0.3281)	(0.5058)	
Δ Policy Rate, 2021Q2-22Q2		0.1887	0.2442		− 0.8288**	− 0.1795
		(0.4984)	(0.5617)		(0.3840)	(0.5026)
Rel. GDP per Capita (2019)		0.0333	− 0.0163		− 1.1476***	0.0480
		(0.0411)	(0.0520)		(0.3695)	(0.0391)
Rel. CPI (2019)		− 0.0204	− 0.0348		− 0.0045	− 0.0279
		(0.0422)	(0.0436)		(0.0487)	(0.0285)
Current Account/GDP (2019)		0.1521	− 0.0807		− 0.7433***	− 0.1781
		(0.2330)	(0.3095)		(0.2360)	(0.2559)
NIIP/GDP (2019)		0.0016	0.0089		0.1141**	0.0136
		(0.0151)	(0.0163)		(0.0422)	(0.0139)
Exchange Rate Stability (2019)		− 10.3033	− 4.5642		0.6444	− 16.9897**
		(8.7014)	(9.5489)		(8.7417)	(8.2616)
Trade Openness (2019)		0.0324	0.0339		− 0.0068	0.1143*
		(0.0514)	(0.0542)		(0.0912)	(0.0587)
Oil & Fuel Exports (2019)		− 0.1080	− 0.0567		0.0627	− 0.1479*
		(0.0876)	(0.0930)		(0.1491)	(0.0841)
Oil & Fuel Imports (2019)		− 0.0216	0.0711		− 0.2740	− 0.0878
		(0.2167)	(0.3363)		(0.3653)	(0.1678)
External Debt/GNI (2019)					0.1245	
					(0.0770)	
FX Intervention, May 2021-Sep 2022						− 2.0514**
						(0.7973)
FX Reserves/GDP × FX Intervention						0.0449**
						(0.0210)
Constant	23.3637***	24.9982***	26.6400***	22.5877***	38.5309***	23.8042***
	(3.0280)	(7.7439)	(9.1281)	(2.6189)	(12.8417)	(6.6548)
Observations	84	52	51	51	32	47
R-squared	0.0909	0.2304	0.2716	0.2283	0.5225	0.4122
RMSE	16.16	10.25	10.32	9.524	8.688	9.263

Notes: Regressions include countries with depreciations below 100% during the 2021-2022 US dollar appreciation. Countries with zero exchange rate variation during the episode are excluded. Column 4 considers all variables from column 3 but uses a backward variable selection procedure with a threshold of 20% for the p-value. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2020).[3] First, we consider a simple two-period setup in the spirit of differences-in-differences:

$$p_{it} = \mu + \gamma_i + \delta_t + \boldsymbol{\beta} X_i D_t + \epsilon_{it} \quad (1)$$

where p_{it} is the log exchange rate vis-á-vis the USD for country i in period $t \in \{0,1\}$. Period 0 denotes the period before the dollar appreciation and Period 1 denotes the treatment period of dollar appreciation. Country and time-fixed effects are given by γ_i and δ_t, respectively. The variable X_i contains a set of *ex-ante* or pre-treatment values of country fundamentals and currency factors including FX reserves, and D_t denotes an indicator equal to 0 in the pre-event period and equal to 1 in the treatment period. The vector of coefficients of interest, $\boldsymbol{\beta}$, captures the relationship between country i's *ex-ante* country fundamentals and its *ex-post* depreciation vis-á-vis the dollar. As our setting involves two periods, the specification can be expressed in a simpler form by taking differences of the dependent variable to consider the exchange rate return over the treatment period:

$$\Delta p_i = \alpha + \boldsymbol{\beta} X_i + u_i \quad (2)$$

where $\Delta p_i = p_{i1} - p_{i0}, \alpha = \delta_1 - \delta_0$ and $u_i = \epsilon_{i1} - \epsilon_{i0}$. Therefore, our empirical specification takes the form of a cross-sectional regression of the percent depreciation of currency i over the treatment period May 2021-September 2022 on *ex-ante* fundamentals observed before the treatment period. Our choice of a May 2021 starting date is motivated by the *de facto* monetary tightening that began at that time, depicted as inflection points in the trajectories of the shadow rate Wu and Xia (2016) and proxy rate Choi et al. (2022) (Fig. 1). Soon after, the June 2021 FOMC meeting entailed communication of a sooner-than-expected end to QE and an accelerated timetable for interest rate increases. The shadow rate and proxy rate began rising faster in November 2021 when the Fed officially began tapering asset purchases as anticipated. As such, we also present results using the November 2021 - September 2022 period.

We provide details on the variables considered in the online appendix: FX reserves, FX interventions, policy rates, GDP, inflation, current account balance, net international investment position (NIIP), financial development, financial openness, trade openness, *de facto* exchange rate stability, trade exposure to oil and fuel, external debt, rule of law, REER misalignment, and commodity terms-of-trade.

3. Results

Regression results examining the sample of depreciating currencies over the 2021-22 dollar appreciation episode are reported in Table 1. Results examining both appreciating and depreciating currencies are

[3] Eichengreen and Gupta (2015) and Ahmed et al. (2017) use cross-sectional regressions to investigate the determinants of exchange rate changes over the 2013 Taper Tantrum period. Ahmed (2020) examines cross-sectional exchange rate changes of oil exporters and importers following an unexpected oil supply shock in 2019.

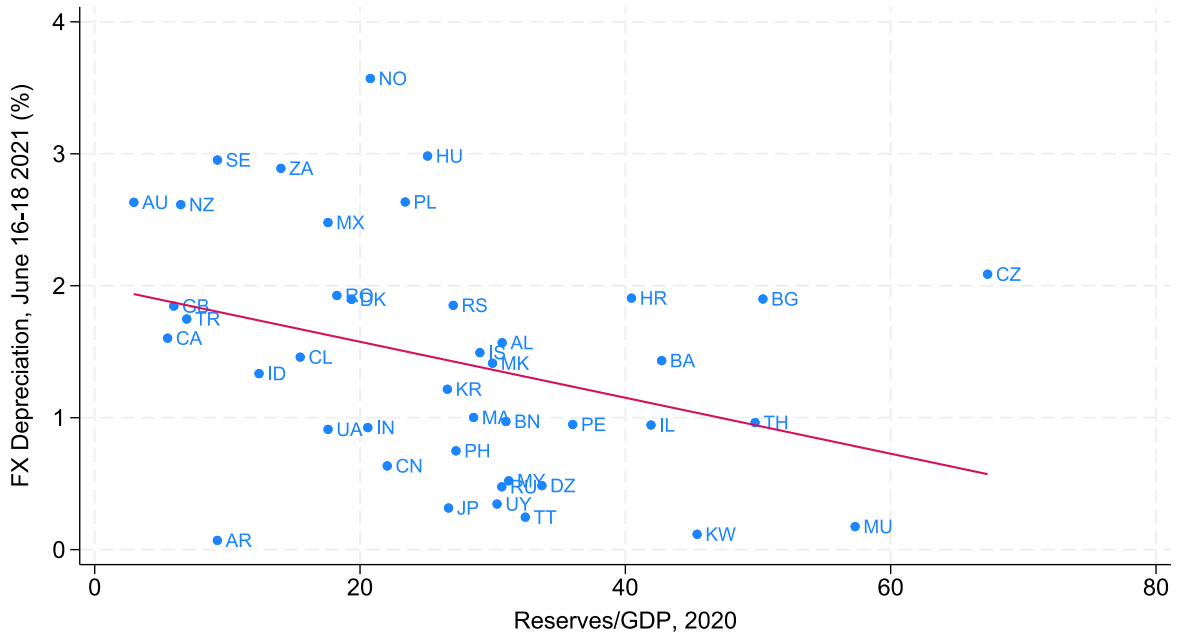

Fig. 3. *Ex ante* reserves and FX depreciation from June 16–18, 2021. Note: FX depreciation on the y-axis corresponds to the percent depreciation against the US dollar from June 16 to June 18, 2021 following the June 16 FOMC announcement. The correlation between reserves and exchange rate changes is -0.3445 and significant at the 5% level (N=42). Countries with Reserves/GDP exceeding 100% are excluded. Regression coefficient of -0.0212 with robust standard errors of (0.0102), significant at the 5% level.

similar and presented in Table A.3 of the online appendix and Table A.4 reports results after adding additional covariates to control for a country's *ex ante* rule of law, *ex ante* exchange rate misalignment, and concurrent change in terms-of-trade.[4] Table A.6 presents results using November 2021 instead of May 2021 as the starting date of the monetary tightening cycle and Table A.7 presents results after replacing FX depreciations with exchange market pressure of Goldberg and Krogstrup (2023) as the dependent variable.

Across all specifications, the level of *ex-ante* FX reserves is significantly associated with lower *ex-post* currency depreciation against the USD. For example, column 2 in Table 1 suggests that the depreciation of the exchange rate against the dollar was reduced by 1.7 percent per every additional 10 percentage points (pp) of FX reserves/GDP held. The effect of holding reserves is also heterogeneous and stronger among less financially developed countries (columns 3, 4, 5). Higher policy rates also appeared to stem currency depreciation. A policy rate that was 1 pp higher was associated with 0.348 percent less depreciation against the dollar (column 2), and this effect is substantially larger among more financially open countries (columns 3, 4, 5). These results suggest some substitutability between holding FX reserves and using the policy rate for exchange rate management, and also that holding FX reserves might enable domestic monetary policy to better target domestic objectives. Column 5 includes external debt as a control. Although the sample size is reduced, larger external debt positions, larger NIIP, and larger current account deficits all appear to be associated with greater currency depreciation.

Table A.5 of the online appendix provides selected results on regional sub-samples by using an interaction term between FX reserves and regional indicator variables. In some regions such as Latin America, Middle East and North Africa, and Sub-Saharan Africa, the negative association between *ex-ante* FX reserves and *ex-post* currency depreciation was especially pronounced.

Balance Sheet Vs. Intervention Channels

Column 6 in Tables 1 and A.3 presents evidence distinguishing between mechanisms through which FX reserves mitigated currency depreciation. On one hand, a 'balance sheet' channel implies that strong fundamentals from holding large FX reserves reduce currency risk even in the absence of using these reserves to intervene. Alternatively, the 'intervention' channel suggests that large-reserve countries can directly intervene to defend their currencies against depreciation. We proxy for country-specific direct FX intervention/GDP (FXI) over the May 2021-September 2022 period using the dataset of Adler et al. (2021). After including FXI in the regressions, the main effect of FX reserves remains large and significant at -0.161 while the coefficient on FXI is significant and negative and the interaction of *ex ante* FX reserves with FXI is significant and positive. Based on these estimates from column 6, a large-reserve country that intervened (i.e., sold reserves) saw less depreciation than an equally large-reserve country that did not intervene so long as their *ex ante* FX reserves amounted to approximately 46 percent of GDP or more. For countries with fewer FX reserves, intervening did not appear to offer additional benefits over holding FX reserves.[5] Similar results are present when the sample is expanded to include currencies that both appreciated or depreciated (Table A.3). Overall, these results support the presence of both balance sheet and intervention channels of FX reserves.[6]

Evidence from the June 2021 FOMC meeting

To validate that our results are related to US monetary tightening and not other factors that drove the USD over the same period, we tested

[4] Rule of law as of 2019 is taken from the World Bank Worldwide Governance Indicators. Exchange rate misalignment is measured as the 2019 REER level as a percentage of its 2014-2018 mean. Country-specific GDP-weighted commodity terms-of-trade changes are calculated between May 2021 and September 2022 using the monthly database of Gruss and Kebhaj (2019).

[5] One possible reason for this result is that market participants perceive the risks associated with depleting reserves as outweighing the benefits of intervention for countries with fewer reserves to begin with.

[6] See Figures A.2 and A.3 for graphical representations of the interaction between FX reserves, FX Interventions and currency depreciation.

whether *ex ante* FX reserve holdings could explain cross-sectional currency returns during the days following an important Fed monetary announcement. We identified June 17, 2021 as recording the largest single-day move in the US dollar within our sample period of interest, following the June 16, 2021 FOMC announcement that surprised markets by communicating a sooner-than-expected end to QE and an accelerated timetable for interest rate hikes.[7] The broad USD appreciated by 1.31%, a +3.75 standard deviation appreciation and the largest daily change between May 2021 and September 2022. As such, we examine FX depreciations against the USD from June 16 to June 18 for 42 countries under the assumption that changes in exchange rates during this window were driven primarily by US monetary policy. Fig. 3 shows that cross-country differences in *ex ante* FX reserves/GDP explained roughly 12% of the cross-country differences in realized depreciation the days following the June FOMC meeting. An additional 10 percentage points of FX Reserves/GDP held *ex ante* were associated with 0.21% less depreciation against the dollar and this estimate is statistically significant at the 5 percent level.[8]

4. Concluding remarks

This paper presents new evidence for the buffering effect of holding FX reserves on currency depreciation during the recent Fed tightening episode and ensuing US dollar appreciation observed from May 2021 to September 2022. Using a broad cross-section of countries, we document statistically and economically significant estimates implying that on average, every additional 10 percentage points of FX reserves/GDP were associated with 1.5 to 2 percent less exchange rate depreciation. This buffering effect of reserves is more pronounced among less financially developed countries. Moreover, large-reserve countries that intervened by selling reserves saw further reductions in exchange rate depreciation than large-reserve countries that did not intervene. Higher *ex-ante* policy rates were also associated with less currency depreciation, and the effects of higher policy rates were stronger in more financially open economies. Exploiting daily FX return variation around the June 2021 FOMC meeting, we further verify the significant buffer effect of FX reserves on currency depreciation. Taken together, the results support the buffering role of FX reserves through both balance sheet and intervention channels and its potential to promote monetary policy independence in the presence of international spillovers.

Data availability

Data will be made available on request.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.econlet.2023.111367.

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[7] See https://www.reuters.com/business/dollar-keeps-climbing-after-feds-hawkish-surprise-2021-06-17/.

[8] Daily FX rates are from the BIS. Three countries with Reserves/GDP exceeding 100% are excluded from the analysis. The result is robust and marginally strengthens under a log-transformation of Reserves/GDP inclusive of countries with Reserves/GDP exceeding 100%.