NBER WORKING PAPER SERIES

ON THE EFFECTIVENESS OF FOREIGN EXCHANGE RESERVES DURING THE 2021-22 U.S. MONETARY TIGHTENING CYCLE

Rashad Ahmed
Joshua Aizenman
Jamel Saadaoui
Gazi Salah Uddin

Working Paper 30935
http://www.nber.org/papers/w30935

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2023

The financial support of the Dockson Chair research fund of the University of Southern California is gratefully acknowledged. The views expressed herein are those of the authors and do not necessarily reflect the views of the Office of the Comptroller of the Currency, U.S. Department of the Treasury, the National Bureau of Economic Research, or other affiliated institutions.

At least one co-author has disclosed additional relationships of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w30935

On the Effectiveness of Foreign Exchange Reserves During the 2021-22 U.S. Monetary Tightening Cycle

Rashad Ahmed, Joshua Aizenman, Jamel Saadaoui, and Gazi Salah Uddin

NBER Working Paper No. 30935
February 2023
JEL No. F32,F40,F68

ABSTRACT

This paper examines the role of foreign exchange (FX) reserves and other fundamental factors in explaining cross-country differences in foreign currency depreciation observed over the 2021-22 Federal Reserve monetary policy tightening cycle that led to a sharp appreciation of the US dollar. Using a broad cross-section of over 50 countries, we document that an additional 10 percentage points of FX reserves/GDP held ex-ante was associated with 1.5 to 2 percent less exchange rate depreciation. We also find that higher ex-ante policy rates were associated with less depreciation, especially among financially open economies. Taken together, these results support the buffering role of FX reserves and their potential to promote monetary policy independence in the presence of global spillovers.

Rashad Ahmed
Office of the Comptroller of the Currency
U.S. Department of the Treasury
rashad.ahmed@occ.treas.gov

Joshua Aizenman
Economics and SIR
University of Southern California
University Park
Los Angeles, CA 90089-0043
and NBER
aizenman@usc.edu

Jamel Saadaoui
BETA, CNRS, University of Strasbourg
46 Avenue de la Foret Noire
Strasbourg 67000
France
jamelsaadaoui@gmail.com

Gazi Salah Uddin
Department of Management and Engineering
Linköping University
Linköping 58183
Sweden
gazi.salah.uddin@liu.se

1. Introduction

2022 was marked by an unprecedented acceleration of inflation that prompted the Federal Reserve to embark on its most aggressive monetary tightening cycle since at least 1983. On the back of substantially higher interest rates and balance sheet reduction through Quantitative Tightening, the US broad dollar appreciated more than 15% from May 2021 to September 2022 (Figure 1). Figure 2 shows that foreign currency depreciations against the dollar over this period were large but also highly uneven, and it remains unclear whether and to what extent such differential exchange rate adjustments arose from differences in country fundamentals or policy configurations.

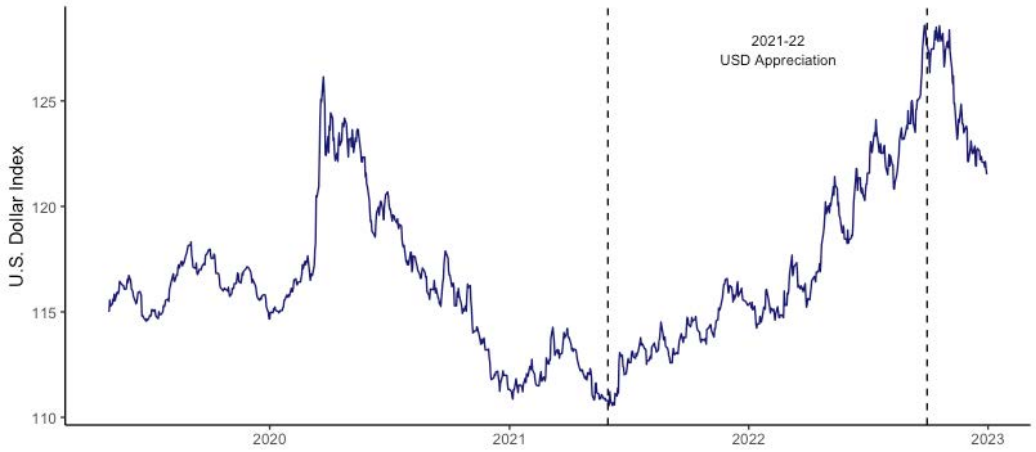

Figure 1. The nominal broad US dollar index

Note: Vertical dashed lines correspond to the episode of US dollar appreciation studied. Source: FRED. The broad nominal dollar index is a weighted average of dollar exchange rates against U.S. major trading partners.

This paper explores these issues systematically by examining whether fundamental factors can explain the extent of currency depreciation 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 realized over May 2021-September 2022 driven by the unexpected and sharp episode of US dollar appreciation. We test whether holding FX reserves mitigated depreciation pressures while controlling for cross-country differences in policies and economic fundamentals. This recent episode of US dollar appreciation presents a novel setting to test the effectiveness of FX reserves, as the extent

of global market stress during this period was not just unexpected but also generated large and heterogenous spillovers to the rest of the world.

We find that over the May 2021- September 2022 period, the amount of FX reserves held *ex-ante*, i.e., in 2020, was a significant predictor of the extent of currency depreciation realized by a given country. We also find an important role in the level of the policy rate. Countries with higher *ex-ante* policy rates realized significantly less *ex-post* depreciation and this association was stronger in more financially open countries.

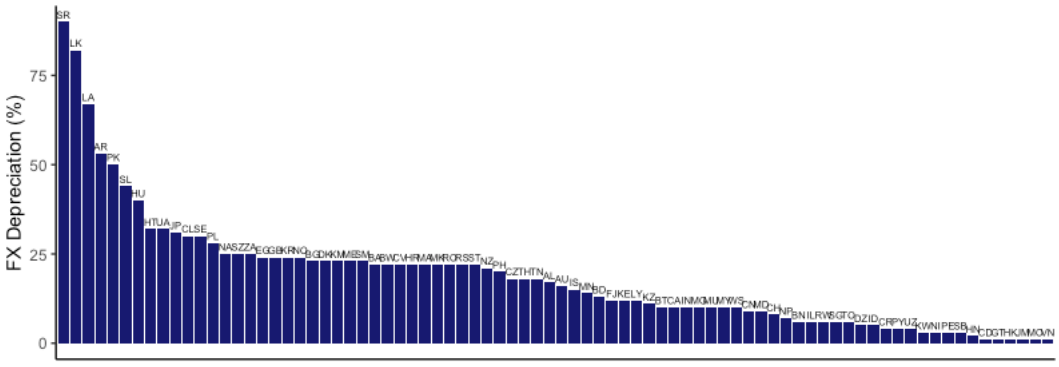

Figure 2. Distribution of FX depreciation

Note: FX depreciation on the y-axis corresponds to the percent change against the US dollar from May 2021 to September 2022

While a large literature tries to explain why countries accumulate reserves (Aizenman and Lee, 2007; Cabezas and De Gregorio, 2019, Chinn and Ito, 2022), we specifically study the consequences of holding reserves in the presence of global shocks (Aizenman and Riera-Crichton (2008), Dominguez et al., (2012), Kohlscheen (2020)). Specifically, we exploit the recent 2021-22-dollar appreciation as a novel episode that allows us to identify the buffering role of holding reserves on exchange rates. Closely related to our analysis are Eichengreen and Gupta (2015), Aizenman et al. (2016), 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 and presents new evidence by harnessing a large cross-section of countries to study the role of FX reserves along with other fundamentals over one of the steepest, most recent episodes of US monetary tightening.

2. Empirical framework

Our empirical strategy follows the cross-sectional regression analyses of Eichengreen and Gupta (2015), Ahmed et al. (2017), and Ahmed (2020).[1] First, consider a simple two-period setup in the spirit of differences-in-differences:

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

where p_{it} is the log exchange rate vis-à-vis the USD for country i in period $t \in \{0,1\}$. Period 0 denotes the period before the dollar appreciation began 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-à-vis the dollar. Because 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:

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

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 to September 2022 on *ex-ante* fundamentals observed before the treatment period. These *ex-ante* fundamentals include: FX reserves/GDP, policy rates, GDP, inflation, current account

[1] 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.

balance, international investment position, financial openness, trade openness, *de facto* exchange rate stability, and trade exposure to oil and fuel.[2] Identification is achieved under the assumption that these countries did not anticipate the extent of Federal Reserve tightening and the ensuing US dollar appreciation that came with it.

3. Results and discussion

Regression results are reported in Table 1. Our first set of results (columns 1, 2, and 3) examines the sample of depreciating currencies over the 2021-22-dollar appreciation episode. Our second set of results (columns 4, 5, and 6) examines the sample of both depreciating and appreciating currencies. Columns 3 and 6 report estimates from regressions using backward variable selection procedures as a robustness check.

Across all specifications and sub-samples, the level of *ex-ante* FX reserves is significantly associated with lower *ex-post* currency depreciation against the USD. Column 2, for example, suggests that for every additional +10 percentage points (pp) of FX reserves/GDP held, the exchange rate depreciated 1.8 percent less against the dollar. Higher policy rates also appeared to help stem currency depreciation. A policy rate 1 pp higher was associated with roughly 1.5 percent less depreciation against the dollar (column 3), and this effect is significantly stronger in countries that are more financially open: a 1 pp higher policy rate was associated with roughly 2.5 percent less depreciation in the most financially open economies.[3] 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.

Importantly, the coefficients on fuel exports and imports are negative and positive, respectively, although insignificant. This suggests that the exchange rates of oil exporters were buffered by the

[2] Data details are provided in the online appendix available here: https://www.jamelsaadaoui.com/wp-content/uploads/2023/01/Online_appendix_AASU_2023.pdf

[3] The financial openness index takes values ranging from -2 to 2, 2 being the most financially open.

concurrent 28 percent rise in global oil prices over the same period the dollar appreciated, as their exchange rates depreciated less against the dollar. By contrast, oil-importing countries realized additional depreciation pressure on their exchange rates as their economies were hit by both a sharply stronger dollar and rising fuel costs at the same time.

Table A3 of the online appendix provides selected results on regional sub-samples by interacting FX reserves with regional indicator variables. For some regions such as Latin America, Middle East and North Africa, and Sub-Saharan Africa, the association between *ex-ante* FX reserves and *ex-post* currency depreciation are even stronger than the sample average.

5. Conclusion

This paper presents new evidence on 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 over 50 countries, we document statistically and economically significant estimates implying that every additional 10 percentage points of FX reserves/GDP were associated with 1.5 to 2 percent less exchange rate depreciation.

Table 1. Main regressions

	Depreciations Only			Depreciations & Appreciations		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Δp_i	Δp_i	Δp_i	Δp_i	Δp_i	Δp_i
FX Reserves/GDP (2020)	-0.1778***	-0.1807**	-0.1300***	-0.1346**	-0.2360**	-0.1995***
	(0.0506)	(0.0789)	(0.0284)	(0.0527)	(0.0884)	(0.0660)
Policy Rate (2020)		-0.7061	-1.5053***		-2.0951***	-2.3310***
		(0.7891)	(0.5089)		(0.6154)	(0.5098)
Fin. Openness (2019)		-0.1969			-0.5498	
		(1.7354)			(1.7165)	
Policy Rate × Fin. Openness		-0.3881	-0.5845*		-0.8234*	-0.8264**
		(0.6424)	(0.3291)		(0.4555)	(0.3176)
ΔPolicy Rate, 2021Q2-22Q2		0.2608			-0.2076	
		(0.5744)			(0.5213)	
Rel. GDP per Capita (2019)		0.0394			0.0567	
		(0.0539)			(0.0556)	
Rel. CPI (2019)		-0.0336			-0.0185	
		(0.0453)			(0.0423)	
Current Account/GDP (2019)		0.0262			-0.3356	-0.3233
		(0.2918)			(0.2818)	(0.2400)
NIIP/GDP (2019)		0.0054			0.0233	0.0282
		(0.0165)			(0.0203)	(0.0199)
Exchange Rate Stability (2019)		-6.7165			-0.1119	
		(10.0422)			(8.0756)	
Trade Openness (2019)		0.0359			0.0250	
		(0.0549)			(0.0568)	
Oil & Fuel Exports (2019)		-0.0728			-0.1837	-0.1946
		(0.1006)			(0.1480)	(0.1399)
Oil & Fuel Imports (2019)		0.1210			0.0469	
		(0.3601)			(0.3781)	
Constant	23.3637***	22.9698**	21.1025***	18.0102***	23.7764**	24.5529***
	(3.0280)	(8.8349)	(2.4298)	(3.2246)	(10.1826)	(3.5948)
Observations	84	51	51	96	60	60
R-Squared	0.0909	0.2462	0.1953	0.0360	0.4104	0.3950
RMSE	16.16	10.50	9.622	18.90	12.30	11.61

Notes: Columns 1, 2 and 3 consider countries with depreciations below 100% during the 2021-2022 US dollar appreciation. Columns 4, 5 and 6, include currencies that both appreciated and depreciated during the 2021-2022 US dollar appreciation. In each case, we exclude the countries with zero exchange rate variation during the episode. In column 3 and 6, we use 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.

References

Ahmed, R. (2020). Commodity currencies and causality: Some high-frequency evidence. Economics Letters, 189, 109016.

Ahmed, S., Coulibaly, B., & Zlate, A. (2017). International financial spillovers to emerging market economies: How important are economic fundamentals?. Journal of International Money and Finance, 76, 133-152.

Aizenman, J., Chinn, M. D., & Ito, H. (2008). Assessing the emerging global financial architecture: Measuring the trilemma's configurations over time (No. w14533). National bureau of economic research.

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

Aizenman, J., & Riera-Crichton, D. (2008). Real exchange rate and international reserves in an era of growing financial and trade integration. The Review of Economics and Statistics, 90(4), 812-815.

Aizenman, J., Binici, M., & Hutchison, M. M. (2016). The transmission of federal reserve tapering news to emerging financial markets. International Journal of Central Banking, 12(2), 317-356.

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

Chinn, M. D., Ito, H., & McCauley, R. N. (2022). Do central banks rebalance their currency shares?. Journal of International Money and Finance, 122, 102557.

Dominguez, K. M., Hashimoto, Y., & Ito, T. (2012). International reserves and the global financial crisis. Journal of International Economics, 88(2), 388-406.

Eichengreen, B., & Gupta, P. (2015). Tapering talk: The impact of expectations of reduced Federal Reserve security purchases on emerging markets. Emerging Markets Review, 25, 1-15.

Kohlscheen, E. (2020). Limiting risk premia in EMEs: The role of FX reserves. Economics Letters, 196, 109567.

Appendix for "On the Effectiveness of Foreign Exchange Reserves during the 2021-22 U.S. Monetary Tightening Cycle"

Table A1. Descriptive statistics – Full Sample

	(1)	(2)	(3)	(4)	(5)
Variables	N	Mean	SD	Min	Max
FX Change (Δp_i)	124	16.57	57.14	-33.99	606.8
FX Reserves/GDP (2020)	124	29.79	26.42	0.148	144.1
Policy Rate (2020)	107	3.583	5.072	-0.750	38
Policy Rate Change, 2021Q2-22Q2	96	1.612	3.106	-5	15.85
Rel. GDP per Capita (2019)	124	24.96	32.06	0.789	143.5
Rel. CPI (2019)	116	128.2	52.57	84.46	433.6
Current Account (2019)	120	-1.937	8.564	-34.36	33.90
NIIP (2019)	120	-9.697	153.2	-271.2	914.8
Fin. Openness (2019)	116	0.404	1.510	-1.927	2.311
Exchange Rate Stability (2019)	116	0.605	0.286	0.0605	1
Trade Openness (2019)	115	90.44	56.20	26.45	353.8
Oil & Fuel Exports (2019)	105	15.46	25.06	0	95.24
Oil & Fuel Imports (2019)	108	13.84	7.211	0.528	33.96

Note: Descriptive statistics for full sample of data collected. Details on data description and sources are found in the Appendix. All variables are in units of percentages.

Preliminary analysis

Our outcome variable is the percent depreciation in the exchange rate against the US dollar (positive values indicate local currency depreciation). We exclude countries that realized depreciations over the period exceeding 100%.[4] We consider 2020 levels of FX Reserves/GDP our main covariate of interest. Figure 3 plots *ex-ante* FX Reserves/GDP against subsequent exchange rate changes against the dollar from May 2021 - September 2022. The left-panel shows that conditioning on just currencies that depreciated, the correlation between reserves and exchange rate changes is -0.317 and significant at the 1% level. The right-panel plots reserve against both appreciations and depreciations. The correlation between the two variables is -0.196 and it is significant at the 7% level.

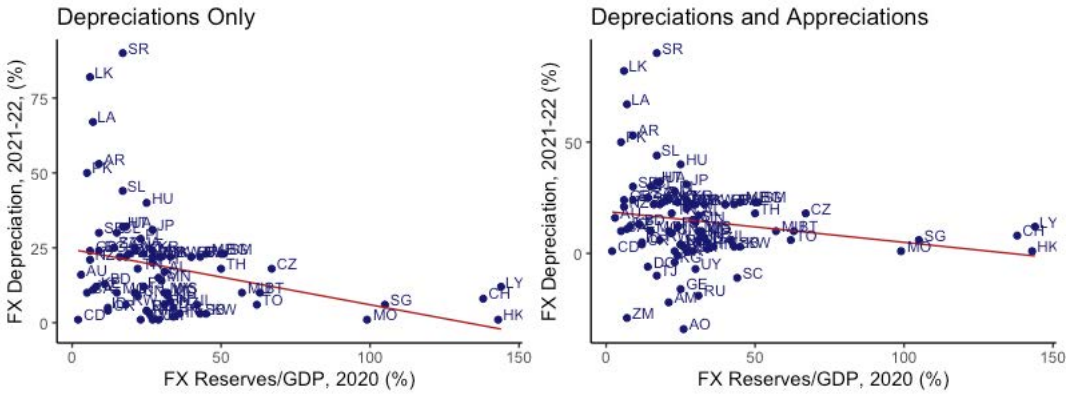

Figure A1. Effectiveness of reserves: *Ex-ante* reserves and *ex-post* FX depreciation

Note: FX depreciation on the y-axis corresponds to percent change against the US dollar from May 2021 to September 2022. Left panel: the correlation between reserves and exchange rate changes is -0.317 and significant at the 1% level. Right panel: the correlation between the two variables is -0.196 and it is significant at the 7% level.

Country list

Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Darussalam, Bulgaria, Cabo Verde, Cambodia, Canada, Cayman Islands, Chile, China, Comoros, DR Congo, Costa Rica, Croatia, Czech Republic, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Eswatini, Fiji, Georgia, Grenada, Guatemala, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iraq, Israel, Jamaica, Japan, Kazakhstan, Kenya, Korea, Kuwait, Kyrgyzstan, Lao PDR, Lebanon, Libya, Macao, Madagascar, Malaysia, Maldives, Mauritius, Mexico, Micronesia, Moldova, Mongolia, Montenegro, Morocco, Namibia, Nepal, New Zealand, Nicaragua, North Macedonia, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Sao Tome and Principe, Saudi Arabia, Serbia, Seychelles, Sierra Leone, Singapore, Solomon Islands, South Africa, Sri Lanka, Suriname, Sweden, Switzerland, Tajikistan, Thailand, Timor-Leste, Tonga, Trinidad and Tobago, Tunisia, Turkey, Ukraine, United Kingdom, United States, Uruguay, Uzbekistan, Viet Nam, Zambia, Zimbabwe.

[4] Two countries are excluded: Turkey and Zimbabwe. Our results are not driven by outliers and is robust to excluding additional countries that realized very large depreciations but less than 100%.

Table A2: Data sources

Variables	Definition	Source	Identifier \ website
FX Change	Percent change of exchange rate against the US dollar between May 2021 and September 2022	International Financial Statistics, IMF	ENDA_XDC_USD_RATE
FX Reserves/GDP	2020 International-reserves-to-GDP ratio	World Development Indicators, World Bank	FI.RES.XGLD.CD; NY.GDP.MKTP.CD
Policy Rate	Policy rate in 2020Q4	International Financial Statistics, IMF	FPOLM_PA
Policy Rate Change	Variation of policy rate between 2021Q1 and 2022Q2. When unavailable, deposit rates were used	International Financial Statistics, IMF	FPOLM_PA
Deposit Rate	Deposit rate in 2020Q4	International Financial Statistics, IMF	FIDR_PA
Deposit Rate Change	Variation of deposit rate between 2021Q1 and 2022Q2	International Financial Statistics, IMF	FIDR_PA
Relative GDP per Capita	GDP per capita in 2019 relative to the US	World Development Indicators, World Bank	NY.GDP.PCAP.KD
Relative CPI	Consumer price index in 2019 relative to the US	International Financial Statistics, IMF	PCPI_IX
Current Account	Current account balance in 2019	World Development Indicators, World Bank	BN.CAB.XOKA.GD.ZS
NIIP	Net international investment position in 2019	Lane and Milesi-Ferretti's database	https://www.brookings.edu/research/the-external-wealth-of-nations-database/
Financial Openness	Capital account openness in 2019	Chinn and Ito's database	https://web.pdx.edu/~ito/Chinn-Ito_website.htm
Exchange Rate Stability	Exchange rate stability in 2019	Aizenman, Chinn and Ito's database	https://web.pdx.edu/~ito/trilemma_indexes.htm
Trade Openness	Trade openness (exports plus imports on GDP) in 2019	World Development Indicators, World Bank	NE.TRD.GNFS.ZS
Oil and Fuel Exports	Fuel exports on total exports in 2019	World Development Indicators, World Bank	TX.VAL.FUEL.ZS.UN
Oil and Fuel Imports	Fuel imports on total imports in 2019	World Development Indicators, World Bank	TM.VAL.FUEL.ZS.UN

Table A3: Country group regressions

Variables	(1) LAC Δp_i	(2) MENA Δp_i	(3) SSA Δp_i
FX Reserves/GDP	-0.1511***	-0.1211***	-0.0914***
	(0.0298)	(0.0275)	(0.0269)
Oil & Fuel Exports (2019)	-0.0721		
	(0.0517)		
FX Reserves/GDP × LAC	-0.4733***		
	(0.0816)		
FX Reserves/GDP × MENA		-0.8433***	
		(0.1011)	
FX Reserves/GDP × SSA			-0.2974***
			(0.0850)
Policy Rate (2020)	-1.5347***	-1.8501***	-1.1401***
	(0.4704)	(0.5182)	(0.3834)
Policy Rate × Fin. Openness	-0.4722	-0.6784*	
	(0.3045)	(0.3626)	
Exchange Rate Stability (2019)			-12.0498**
			(5.6815)
MENA		27.6067***	
		(3.7692)	
SSA			14.2850***
			(3.9840)
Constant	24.4379***	21.5489***	24.4649***
	(2.5491)	(2.5227)	(3.7702)
Observations	51	51	51
R-squared	0.3772	0.2918	0.2521
RMSE	8.651	9.225	9.479

Note: We include countries with depreciations below 100% during the 2021-2022 US dollar appreciation. We exclude the countries with no exchange rate variations during the episode. In these regressions, we use a backward selection procedure with a threshold of 20% for the p-value. Country groups with no significant differences from the results in column 3 of Table 2 are not shown to save space. Country group composition in these regressions: LAC: Argentina, Chile, Costa Rica, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru, Suriname; MENA: Egypt, Israel, Kuwait, Morocco; SSA: Botswana, Eswatini, Madagascar, Mauritius, Namibia, Rwanda, South Africa. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.