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International Capital Flows and Extreme Exchange Market Pressure: Evidence from Emerging Market Economies

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Abstract

In response to the currency crises in the emerging market economies (EMEs) during the 1990s, earlier studies tended to put emphasis on identifying and explaining currency crash, which is an extreme event mostly associated with massive capital reversals. After the 2008 global financial crisis, the focus shifted towards enormous capital inflows which have put a sharp appreciation pressure on domestic currency and inflated a large housing and construction bubble. In this paper, we examine the foreign exchange instabilities of a group of EMEs between 1995Q1 and 2019Q4 using the exchange market pressure (EMP) index by taking into considerations both extreme positive and negative episodes. The identification of tail observations is carried out under the framework of Extreme Value Theory (EVT) to handle asymmetric and heavy-tailed data. A panel multinomial logit model is used to explore whether the predictors differ between extreme positive and negative EMP events. Our findings show that (1) there is asymmetry in the EMP distributions, where the occurrence of currency crises is more frequent than excessive appreciations in most EMEs, (2) portfolio and credit flows are significant predictors to both extreme events, and (3) by distinguishing the residency of capital flows, foreign credit flow is the key factor that contributes to the devaluation pressure in the EMEs.

Keywords Exchange market pressure · Extreme value theory · Capital flows · Emerging market economies · Multinomial logit model

JEL Classification F15 · F21 · F31 · F32

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1 Introduction

The past few decades have witnessed an unprecedented scale of financial integration from the emerging market economies (EMEs) into the world. This burgeoning financial liberalization that swept across the EMEs has attracted tremendous capital inflows which have brought mixed impacts on the EMEs. On one hand, capital inflows from developed countries provide ample liquidity which helps facilitate business expansion and stimulates economic growth of the EMEs. On the other hand, excessive capital flows are often associated with currency appreciation and hence asset price bubble which results in the erosion of external competitiveness. Reliance on foreign financial flows will also expose the EMEs to the risk of 'Sudden Stop' and consequently increase the likelihood of financial crises to the recipient country (Calvo 1998). While financial globalization seems to be an inevitable trend to most EMEs, its pros and cons invite controversial debates. Passari and Rey (2015) even conclude from the findings of existing literature that the benefits of inter- national financial flows are quantitatively elusive and thus should not be taken for granted.

Indeed, ever since the EMEs joined the bandwagon of financial liberalization, their foreign exchange markets have gone through large ups and downs in the midst of massive and volatile capital flows. At the earlier phase of financial globalization, the rapid market reform and loosened regulations had made the EMEs more vulnerable to speculative attacks and external shocks. Despite advanced counterparts experienced improvement in macroeconomic stability during the 'Great Moderation' period, the 1990s marked an extremely volatile era for most EMEs. Full-fledged currency crises preceded by excessive real currency appreciations were seen in emerging countries worldwide. These include the 1994 Mexican Peso Crisis, the 1997 Asian Financial Crisis and the 1998 Russian Ruble Crisis. These severe crises have undoubtedly brought devastating costs, both economic and social, prompting the EMEs to deal with their fundamental weaknesses in the aftermath.

Going forward, the outbreak of Global Financial Crisis (GFC) has sparked concern about whether financial integration among economies has gone too far. In fact, the excessive exposure of European financial institutions to assets associated with U.S. subprime mortgages had been the main culprit behind the Eurozone recession. On the contrary, the EMEs were more resilient to GFC, thanks to the currency regimes and financial market reforms after gaining a lesson from the 1990s. However, the rising global uncertainty in post GFC had definitely inflicted obstacles to their policy makers. The ebb in capital flows and the resulting wide-scale currency depreciations in response to the taper tantrum and recent oil price crisis had substantiated vulnerability of these EMEs towards external shocks.

Against such backdrop, this paper aims to study the proximate determinants of extreme events in foreign exchange markets of a set of emerging countries between 1995Q1 and 2019Q4, with specific attention drawn to the linkage between international capital flows and the extreme foreign exchange events. The objectives of this paper are twofold. First, unlike previous literature that focuses only on depreciation events, we conduct comparative analysis between extreme events of currency appreciation and depreciation pressures. While currency crashes are often thought to be more disruptive and damaging to the real economy, sharp appreciations may also jeopardize real economy through its adverse impact on external competitiveness and thus domestic production.[4] Large fluctuations in either ways are deemed as currency mismanagement that will incur substantial costs to the public and it is therefore important to distinguish the roles of different factors not only for large depreciation but sharp appreciation episodes as well. Second, leveraging gross capital flows data from IMF's Balance of Payment Statistics, we disaggregate capital flows by direction of flows (i.e. gross inflows by foreigners and gross outflows by domestic agents) and investment types (i.e., direct, portfolio and other investments), which allow us to examine relationship between capital flows and extreme events in more details.

To capture total pressure on exchange rate across different currency regimes, we follow the well-established exchange market pressure (EMP) literature by con- structing the composite index which consists of exchange rate changes and foreign exchange intervention terms. This way, exchange rate pressure that is warded off by the monetary authority can be reflected by the intervention terms, hence facilitating our study which looks at a set of emerging countries that mostly adopt managed floating currency regime. We will examine the extreme EMP episodes and the role played by the capital flows along with other macroeconomic variables, by drawing attention to the tail characteristics of the EMP index.

As the extreme EMP episodes are essentially rare events for individual countries, the prediction can be quite challenging especially as standard identification measures may be inaccurate if the data follows a distribution that is very different from normal. This raises concern since the empirical studies have found that EMP index tends to have fat tails like most of the other financial series (Pozo and Amuedo-Dorantes 2003). Moreover, we attempt to identify extreme events in both sides of distribution which is likely to be asymmetric. As such, we apply the identification method based on Extreme Value Theory (EVT), which allows us to address the distributional characteristics of the EMP in a more realistic manner. We then employ the panel multinomial logit/probit model to study whether financial liberalization is associated with foreign exchange market instabilities through distinct capital flows channels. From that, we are able to draw implications to the capital control policies so as to better grapple with the boom-bust cycle in foreign exchange market.

This paper is organized as follows. Section 2 reviews the existing literature. Section 3 presents the stylized facts of the key indicators of this study. Section 4 discusses the identification method of extreme events. Section 5 reports method- ology and results of factors that may drive extreme EMP episodes. Section 6 concludes.

2 Literature Review

The concept of exchange market pressure (EMP) was first introduced by Girton and Roper (1977). It is a composite index that measures currency market stresses which comprises exchange rate movement and foreign exchange intervention terms. The core advantage of using the EMP index lies at its ability to capture unsuccessful speculative attacks that are averted

[4] One such example is Endaka Fukyo, which is a recession period faced by Japan as net exports deteriorated due to strong yen revaluation in the aftermath of 1985 Plaza Accord agreement (Obstfeld 2009)

through official intervention by the monetary authority under a managed float or fixed currency regime. Hence, the EMP index provides a more complete picture than looking at the exchange rate movement alone and serves as a suitable indicator for different currency regimes (Tanner 2002).

Earlier EMP studies concentrate on deriving a model-consistent EMP measure to examine a country's monetary policy stance[5] Such EMP measures have received criticism for their reliance on a particular model and led to development of alter- native EMP measures. A variance-weighted[6] model-independent EMP index first proposed by Eichengreen et al. (1995) for the empirical research on currency crises, has become a popular measure widely adopted by practitioners to explore several important issues in foreign exchange studies. Below we briefly review two main research topics that fall under the umbrella of EMP literature:

2.1 EMP and Currency Crises

In light of the outbreak of systemic currency crises in the EMEs during the end of 20th century, there exists a large number of EMP literature which aims at explaining the factors leading to such crises. One of the seminal works is conducted by Eichen- green et al. (1995) where they define currency crises as periods when speculative pressure faced by a currency—as indicated by EMP—exceeds 2 standard deviations above its mean. The EMP index is converted into discrete categorical variable and a probit model is used to investigate the determinants of currency crises for a panel of twenty OECD countries from 1959 to 1993. They find that devaluations are preceded by political instability, budget and current account deficits, rapid money expansion and price inflation. Likewise, Eichengreen et al. (1996) find evidence of contagion where the impact is more pronounced for countries that are closely tied by trade linkage.

Using similar definition of currency crisis, another group of EMP studies focuses on building the Early Warning System to predict future currency crisis. Kaminsky et al. (1998) and Kaminsky (1999) propose the signals approach, in which leading indicator exceeding a certain threshold is seen as a warning signal. These signals are tested on their accuracy in predicting a crisis which may take place within a 24-month window. Among fifteen individual variables, the results show that real exchange rate appreciation gives the best signal along with other useful indicators including exports, money condition, output and equity prices. Boonman et al. (2019) investigate performance of Early Warning System using both signal and logit model with real-time data. They conclude that current-vintage data perform better than real-time indicator forecasts in terms of predicting currency crises.

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[5] For instances, Weymark (1995, 1998), Burdekin and Burkett (1990) conduct EMP research for Canada; Connolly and Da Silveira (1979) for Brazil; Brissimis and Leventakis (1984) for Greece; Kim (1985) for Korea; Thornton (1995) for Costa Rica; Baig et al. (2003) for India; Parlaktuna (2005) for Turkey; Jeisman (2005) for Australia; De Macedo et al. (2009) for five African countries.

[6] Pentecost et al. (2001) propose Principal Component Analysis (PCA) to determine weights of EMP components. Hegerty (2013) compare PCA measure with variance-weighted measures. He finds that many countries' EMP components do not produce appropriate principal components and concludes that PCA measure might not serve as a definitive improvement over the variance-weighted measure.

While these studies have paved ground for the application of EMP in empirical research of currency crises, the conventional standard deviation based approach in identifying crisis could be criticized for its arbitrariness as there is no consensus on a single optimal threshold value adopted in numerous studies.[7] Besides, the standard deviation based approach implicitly imposes normality assumption on the EMP distributions. However, the distributions of actual EMP data of most EMEs are non-normal. These drawbacks have motivated our application of Extreme Value Theory (EVT) method in determining currency crises so as to address the distributional characteristics of EMP in a more realistic manner (Pozo and Amuedo-Dorantes 2003).

2.2 EMP and Capital Flows

In response to the GFC and taper tantrum, the foreign exchange vulnerability of the EMEs has received renewed attention among the researchers. Recent studies have highlighted the importance of capital flows as a main contributor to the EMP. For instance, Hegerty (2009) studies the impact of capital inflows on four Central and Eastern European countries that maintained fixed exchange rates before joining the European Union. The study shows that different countries had different responses to the inflows, but the relatively volatile non-FDI inflows significantly affect EMP in three out of four countries. Aizenman et al. (2012) investigate determinants of EMP in the emerging markets between both the Great Moderation and the GFC periods. Their results show that financial considerations such as capital outflows and debt deleveraging dominate trade factors in driving up foreign exchange distress during crises. Aizenman and Binici (2016) use quarterly data for 50 OECD and emerging countries over 2000-2014, they find the effect of portfolio and FDI flows on EMP is significant for the EMEs but insignificant for the OECD countries.

These studies provide evidence of the crucial role of capital flows on EMP. Nonetheless, most of these studies focus on continuous EMP index as dependent variable, and as such, do not distinguish between normal swings and large fluctuations in the EMP index. Moreover, the crisis-period analysis is based on sub-sample study, which is not able to capture unusual EMP observations that are country- or region-specific which do not fall within the GFC period.

Extending from the previous literature, this paper seeks to explore factors that may explain large fluctuations in foreign exchange markets of a set of emerging countries. Unlike recent studies that apply continuous EMP index, we focus only on the “anomalies” in the currency markets. This paper overlaps with the literature of currency crises in the sense that crises are essentially extreme events at the positive tail of EMP distribution. Nonetheless, large currency appreciation is also a source of instability that concerns policymakers, given its potential adverse effect on external competitiveness and domestic output.[8] We are interested to

[7] For instance, Komulainen and Lukkarila (2003) define threshold as mean plus 2 standard deviations. Kaminsky and Reinhart (2000) use threshold of mean plus 3 standard deviations.

[8] According to Mundell-Fleming model, at a given policy rate, capital inflows are contractionary to the real economy through exchange rate appreciation (Blanchard et al. 2016). Kappler et al. (2013) identify large nominal and real appreciations and find that these episodes are associated with deterioration in current account balances. Mehrotra (2007) finds that in both Japan and Hong Kong, an appreciation in nominal effective exchange rate leads to a statistically significant decline in real output and price level. Ghosh and Rajan (2007) study the degree of nominal effective exchange rate pass-through into the

study predictors to both extreme depreciation and appreciation episodes. Hence, this paper follows the EVT method as inspired by Haile and Pozo (2006, 2008) to identify the extreme events in both tails of EMP distribution.

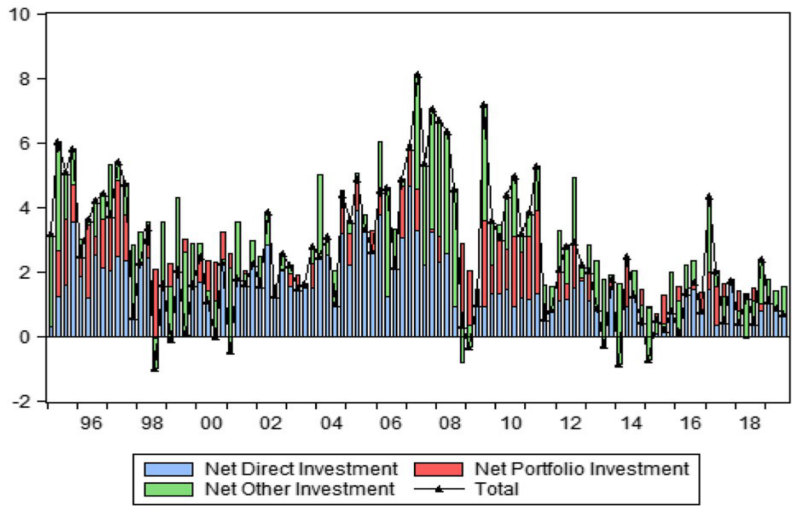

Fig. 1 Net inflows (as share of GDP) by investment type

3 Stylized Facts and Preliminary Analysis of Key Indicators

In this section, we show the stylized facts and preliminary analysis of our key indicators, capital flows and EMP, to provide the rationale for discrimination between capital flow channels and application of EVT method in this study.

3.1 Development and Trend of Capital Flows

Figure 1 shows the breakdown of capital flow components by investment type between 1995Q1 and 2019Q4 for the 21 emerging countries in our sample. The overall trend of capital flows to EMEs was quite volatile throughout the period. Large inflows typically occurred prior to the outbreak of crises but reduced sharply at the height of the crises. These V-shaped patterns are observed during the 1995 Latin American crisis, 1998 Asian Financial Crisis and 2008 Global Financial Crisis. Another massive wave of capital flows to EMEs was triggered when the advanced countries unleashed the Quantitative Easing programme in post GFC. This trend has reversed when the tapering concern emerged in 2011. The recent troughs in capital flows within our sample correspond to the taper tantrum in 2013 and oil price collapse in 2014.

export prices of Korea, Thailand and Singapore and find asymmetric pass-through between appreciation and depreciation.

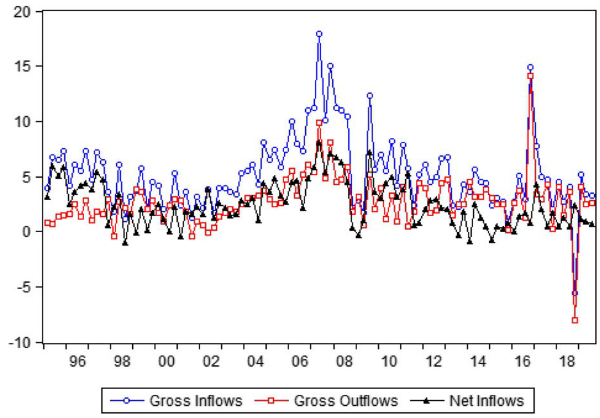

Fig. 2 Gross vs net flows (as share of GDP)

It is noteworthy that these abrupt changes in capital flows are mostly driven by portfolio and other investments.[9] In fact, existing literature has also pointed out the importance of the composition of capital flows on exchange rate fluctuations given that short term flows are subject to higher risk of sudden reversals (Ahmed and Zlate 2014). Among various inflows, foreign direct investment (FDI) is commonly viewed as more stable and benign flows. On the other hand, portfolio debt and credit inflows are found to be more sensitive to global shock due to their strong pro-cyclical nature (Rey 2015). It is therefore imperative to distinguish among components of capital flows in order to gain a better understanding of their role as a shock propagator during crisis.

Apart from investment type, a number of capital flows study focuses on the residency of flows. For instance, Forbes and Warnock (2012) detect the extreme movements of capital flows by using the gross (as opposed to net) flows data. In Balance of Payment statistics, gross inflows as driven by the nonresidents are indicated as liabilities, whereas gross outflows as driven by the residents are recorded as assets. Net inflows are the difference between liabilities and assets. As shown from Fig. 2, net inflows move in tandem with gross inflows most of the time but such positive correlation had been weakening in recent periods especially during 2018 when there was even negative correlation between both net and gross inflows. This is due to the increased synchronization between gross outflows and gross inflows, which is in line with the finding of Broner et al. (2013) that whenever foreigners invest in a country, domestic agents invest abroad, and vice versa. They attribute the heterogeneous behaviour between domestic and foreign agents to the presence of sovereign risk and asymmetric information.

[9] Other investments consist mostly of foreign bank lending, which are also known as credit inflows in other studies (Rey 2015)

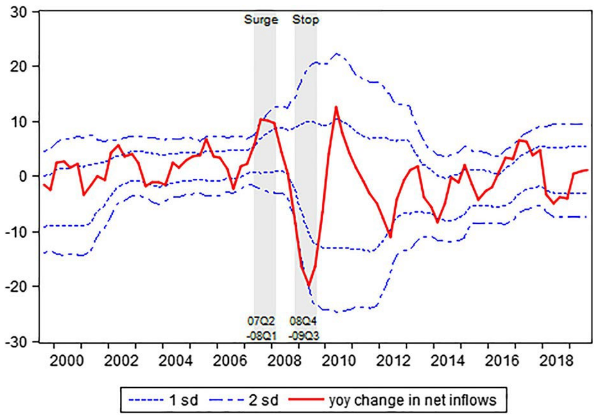

Fig. 3 Change in net inflows

Following method proposed by Forbes and Warnock (2012),[10] Figs. 3 and 4 plot the unusual episodes of both gross inflows and net inflows. Not surprisingly, there are more extreme episodes detected using the gross inflows data. The identification by net inflows not only underestimates the period and severity of stop episode during the GFC, but also omits two surge episodes, one from 2002Q4 through 2005Q1 and another from 2016Q4 through 2017Q3 as identified by gross inflows data. This further sheds light on the importance of addressing differences between net and gross capital flows in the subsequent analysis.

3.2 Distributional Properties of EMP

Following Eichengreen et al. (1995, 1996), the monthly EMP index is a weighted average of exchange rate changes, international reserve changes, and interest rate changes:

$$EMP_{i,t} = \frac{1}{\sigma_{\Delta e}} \%\Delta e_{i,t} - \frac{1}{\sigma_{\Delta IR}} \frac{\Delta IR_{i,t}}{M_{i,t-1}} + \frac{1}{\sigma_{\Delta r}} \Delta\left(r_{i,t} - r_{us,t}\right)$$

where $e_{i,t}$ represents nominal exchange rate of local currency per U.S. dollar, $IR_{i,t}$ stands for international reserves (excluding gold), $M_{i,t-1}$ is money supply in last period, $r_{i,t}$ and $r_{us,t}$ denote money market rate or discount rate of country i and base country (i.e., the US), respectively. Each term is scaled by its own standard deviation to avoid domination of volatile component. An increase in EMP indicates the country's currency is experiencing devaluation pressure, and vice versa.

Figure 5 shows the cross-sectional averages of EMP indices for the emerging countries across Asia, Latin America and Europe. Several large swings can be observed during the time when the region experiences severe crises, implying presence of extreme events.

As mentioned before, when defining extreme episodes using standard deviation threshold, one is making the underlying assumption that the series conforms to the standard

[10] Using 4-quarter moving sum of capital inflows data, we compute the rolling means and standard deviations of the year-over-year(yoy) changes of capital inflows over 12 quarters. Extreme capital inflows episodes are determined when three criteria are met: (1) current yoy changes exceed two-standard- deviations band, (2) the episode lasts for all consecutive quarters for which the yoy changes exceed one-standard-deviation band, (3) the length of the episode is greater than one quarter.

normal distribution. As a preliminary inspection, Fig. 6 shows the histograms of the selected EMP series overlaid by their corresponding normal prob- ability density functions. Apparently, most series are far away from being normally distributed, with quite a number of outliers in the tails and mass of peak observations at the center. The summary statistics presented in Table 1 provide additional evidence of non-normality. Excess kurtosis confirms the presence of fat tails. The sample skewness is nonzero for all countries, pointing to the presence of asymmetry. The monthly EMP indices for all countries show significant Jacque-Bera statistics, indicating rejection of the null hypothesis of normal distribution.

To account for the asymmetric and non-normal characteristics of EMP, identification of large fluctuations is carried out under the framework of EVT, which involves approximation of tail index using the 'right' amount of tail observations. In the next section, we explain how the tail index is approximated and also how the optimal number of exceedances is determined for each country's EMP series.

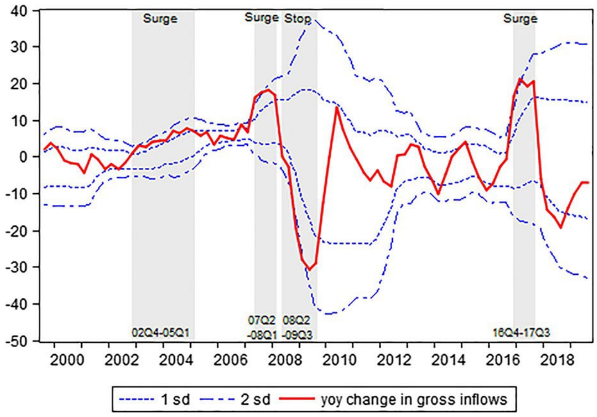

Fig. 4 Change in gross inflows

4 Identifying Extreme EMP Episodes

Extreme Value Theory (EVT) is a robust methodology to study the tail behaviour of a distribution. Its application has gained popularity in finance literature, considering most financial return series are heavy-tailed and asymmetric (De Haan et al. 1994; McNeil 1997).

Within context of EVT, one is focusing on the rare events rather than the sample averages, where the limiting distribution of the latter confines to the normal distribution as stated in the central limit theorem. The convergence of extrema, instead, can be summarized by generalized extreme value distribution (GEV) according to Fisher-Tipett theorem.

Consider a stationary sequence of independently and identically distributed variables, as represented by X_t, $t = 1,2, \dots, N$, with a common distribution function $F(x) = P(X \leq x)$. We denote the sample maxima of the first $n < N$ observations of X_t by $M_n = \max(X_1, \dots, X_n)$. If there exist two normalizing constants $a_n > 0$ and $b_n \in \Re$ and a non-degenerate distribution function H such that $\frac{M_n - a_n}{b_n} \rightarrow H$, then H will belong to one of three types of GEV distribution depending on the shape parameter ξ.

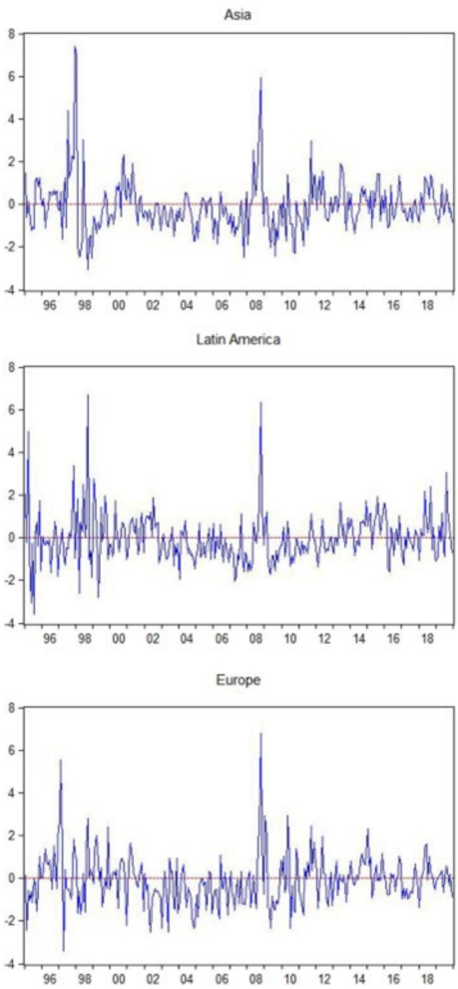

Fig. 5 Regional cross sectional averages of monthly EMP indices (%)

These three distributions are namely Gumbel (thin-tailed, when $\xi = 0$), Frechet (fat-tailed, when $\xi > 0$) and Weibull (no-tailed, when $\xi < 0$), which can be represented by GEV under the single parameter ξ :

$$G_{\xi}(x) = \begin{cases} \exp\{-(1+\xi x)^{-1/\xi}\}, & \text{if } \xi \neq 0, 1+\xi x > 0 \\ \exp\{-\exp(-x)\}, & \text{if } \xi = 0 \end{cases}$$

where the shape parameter $\xi = \frac{1}{\gamma}$ and γ is the tail index. To estimate the tail index of the EMP series, this study employs the nonparametric estimation method as proposed by Hill (1975). By ordering the EMP data as the ascending-order statistics, so that $X_{(i)}$ is the i th-order EMP observation and $X_{(i-1)} \leq X_{(i)}$ for $i = 1, \ldots, n$, the Hill estimator is computed using the following formula:

$$\hat{\gamma} = \frac{1}{k}\sum_{i=1}^{k} \log X_{(k+1-i)} - \log X_{(k-n)}$$

where k is the pre-specified number of tail observations used to compute $\hat{\gamma}$ and n is the sample size. $\hat{\gamma}$ is a consistent and asymptotically normally distributed estimator of γ (Koedijk et al., 1992):

$$\sqrt{k}(\hat{\gamma} - \gamma) \sim N(0, \gamma^2)$$

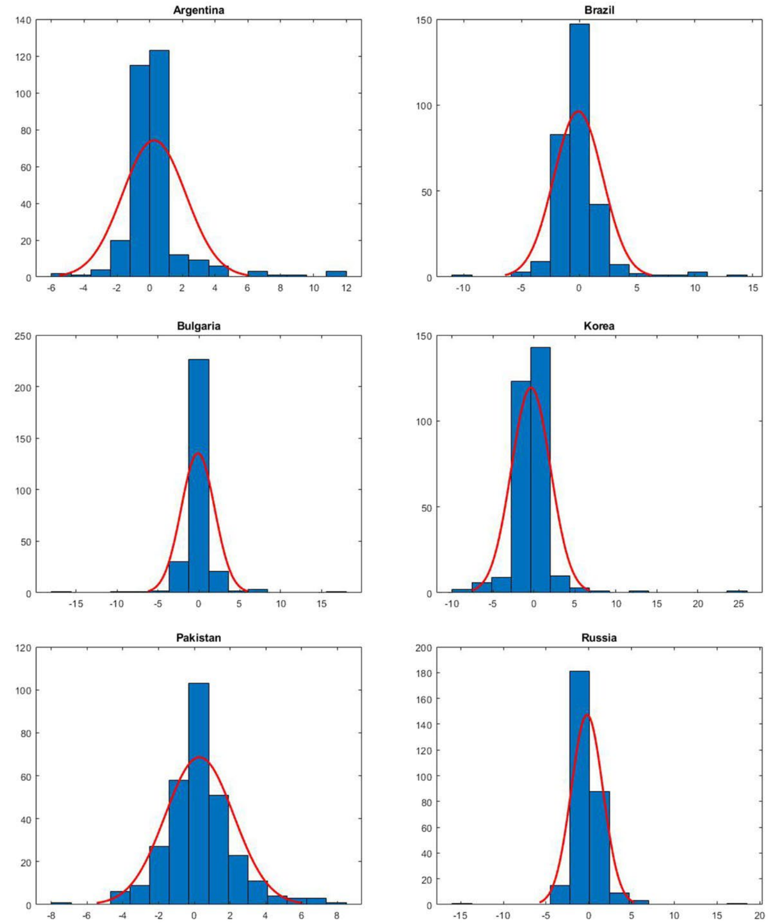

Fig. 6 Histograms of EMP measures and the corresponding normal probability density functions for selected countries

One crucial step of hill estimation is to determine the optimal k. There is a trade-off between bias and variance when we choose the number of tail observations to be included for estimation. If we choose too many tail observations, it is likely to induce bias by including observations which are close to the centre of distribution. On the contrary, estimation with too few observations will yield larger variance. As such, this paper follows the Monte Carlo simulation method adopted in the studies of Longin and Solnik (2001) and Haile and Pozo (2006, 2008), to help optimizing the bias-variance tradeoff and select the suitable threshold.

The simulation method is conducted by first generating pseudo-random numbers of size n from the Studentt distribution with degrees of freedom (df s) ranging from 1 to $10 \cdot$ [11] For each simulated series of size n, the hill estimators ($\hat{\gamma}$) are calculated based on different values

[11] df is allowed to take an increment of 0.1 from 1 to 5 and 0.2 from 5 to 10.

of k. [12] This practice is replicated for 1000 times. We can then compute mean-square error (MSE) of the 1000 hill estimators obtained for a given k and given df Student-t. The optimal k of each df Student-t is the one which minimizes the MSE. After obtaining the optimal k 's for all df Student-t, we will use these to pinpoint the threshold of actual EMP series for each country. Conditional on the optimal k 's, we compare the hill estimators calculated using actual EMP data with the true tail index of the Student-t distributions as given by $\gamma = \frac{1}{df}$, the one which gives the smallest difference will be chosen as the final optimal k for this country.

5 Predictors of Extreme EMP Episodes

5.1 Baseline Regression Model

Following Aizenman and Binici (2016), explanatory variables for EMP can be largely categorized into domestic and external factors:

$$EMP_{it} = \mu_t + \beta_1 X_{it} + \beta_2 KF_{it} + \beta_3 Z_t + \varepsilon_{it} \tag{1}$$

where X_{it} is a vector containing domestic factors such as commodity term of trade, change in GDP per capita, inflation, trade balance, stock market return, and change in domestic credit. KF_{it} are capital flows variables. Z_t includes common external factors such as US interest rates[13] and CBOE VIX index.

In this study, we focus on foreign exchange instabilities that are represented by extreme negative (appreciation) and extreme positive (depreciation) episodes of EMP index, which are essentially categorical dependent outcome. We employ panel multinomial logit regression as our main regression model. As robustness check, we also report multinomial probit regression results. [14]

The multinomial logit model of Equation 1 is given as follows:

$$\log\left(\frac{P(\text{ event }_{ij}=1)}{P(\text{ tranquil }_{i}=1)}\right) = \mu_{jt} + \beta_{1j} X_{it} + \beta_{2j} KF_{it} + \beta_{3j} Z_t + \varepsilon_{ijt}, j = 1,2 \tag{2}$$

where the dependent variable is the relative log odds of the economy i being in extreme event j vs the base outcome. Specifically, base outcome is the tranquil period, event 1 is the extreme positive EMP episode and event 2 is the extreme negative EMP episode. [15]

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[12] k is allowed to vary from 1% to 20% of n.

[13] As US interest rate is used to compute EMPit , it enters as lag into RHS of Eq. 1 to avoid endogeneity problem.

[14] In light of possible fixed effect, the hybrid multinomial logit approach as proposed by Allison (2009) is adopted for further sensitivity check. The qualitative findings are largely similar to our baseline results which are available upon request.

[15] We also control for a third group in which both extreme positive and negative episodes occur within the same quarter. The result is not reported as there are only 36 observations fall within this group.

We collect quarterly data on EME countries from 1995Q1 through 2019Q4. The list of countries and description of variables are shown in Table A1 and A2, respectively, in the Appendix.

Table 1 Descriptive statistics of the monthly EMP indices

Country	Mean	St. deviation	Skewness	Kurtosis	Jacque-Bera
Emerging Asia					
India	−0.23	2.02	1.45	10.06	726*
Indonesia	−0.13	1.90	2.38	24.00	5755*
Korea	−0.37	2.40	3.86	44.64	22344*
Malaysia	−0.09	2.01	1.20	13.26	1384*
Pakistan	0.29	1.92	0.51	5.52	93*
Philippines	−0.14	2.08	1.94	17.10	2662*
Sri Lanka	0.33	1.87	−0.08	6.16	119*
Thailand	−0.22	2.01	1.20	9.81	653*
Latin America					
Argentina	0.27	1.94	2.72	16.20	2546*
Brazil	−0.08	2.11	1.81	15.39	2084*
Chile	−0.02	1.69	0.44	5.82	108*
Colombia	−0.07	1.87	0.42	6.54	166*
Mexico	−0.12	2.30	3.47	35.89	14074*
Peru	−0.15	1.97	0.82	7.59	296*
Emerging Europe					
Bulgaria	−0.11	2.04	0.06	40.40	16786*
Czech Republic	−0.30	2.00	1.05	16.95	2480*
Hungary	−0.09	1.99	0.94	13.98	1551*
Poland	−0.25	1.85	0.14	5.80	99*
Romania	0.06	2.02	2.08	17.27	2761*
Russia	−0.20	1.86	1.88	43.00	20039*
Turkey	0.17	1.89	1.48	9.99	721*

An asterisk denotes rejection of the null hypothesis of a normally distributed series

Table 4 Panel linear regression model

Variables	(1)	(2)	(3)
Constant	−0.227***	−0.244***	−0.229***
	(0.064)	(0.065)	(0.067)
L.World Interest Rate (%Δ)	0.018	0.019	0.018
	(0.013)	(0.013)	(0.013)
VIX (%Δ)	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)
Commodity Term of Trade (%Δ))	−0.015	−0.032	−0.015
	(0.041)	(0.041)	(0.041)
Growth in GDP per capita	−0.044***	−0.043***	−0.044***
	(0.007)	(0.007)	(0.007)
CPI Inflation	0.002	0.003	0.002
	(0.004)	(0.004)	(0.004)
Trade Balance (%GDP)	−0.053***	−0.052***	−0.053***
	(0.010)	(0.010)	(0.010)
Stock Market Returns	−0.015***	−0.016***	−0.015***
	(0.003)	(0.003)	(0.003)
Change in Credit (%GDP)	0.042***	0.043***	0.042***
	(0.005)	(0.005)	(0.005)
Net Portfolio Outflows (%GDP)	0.055***		
	(0.012)		
Portfolio Equity (%GDP)		0.093***	
		(0.022)	
Portfolio Debt (%GDP)		0.037***	
		(0.013)	
Net Direct Outflows (%GDP)	0.050***	0.049***	
	(0.014)	(0.014)	
Net Other Outflows (%GDP)	0.076***	0.077***	
	(0.008)	(0.008)	
Gross Portfolio Outflows (%GDP)			0.052**
			(0.024)
Gross Portfolio Inflows (%GDP)			−0.056***
			(0.013)
Gross Direct Outflows (%GDP)			0.052***
			(0.015)
Gross Direct Inflows (%GDP)			−0.052***
			(0.015)
Gross Other Outflows (%GDP)			0.084***
			(0.014)

Table 4 (continued)

Variables	(1)	(2)	(3)
Gross Other Inflows (%GDP)			−0.073***
			(0.009)
R^2	0.190	0.193	0.190
Observations	1,800	1,777	1,800

Standard errors in parentheses. *, **, and *** denote significance at 10, 5 and 1% level

5.2 Baseline Estimation Results

Table 4 shows fixed effect panel regression results based on Eq. 1 with three specifications: Specification (1) focuses on the composition of net capital outflows by investment types, namely portfolio, direct and other (credit) outflows. Specification (2) further segregates net portfolio outflows into equity and debt investments. Specification (3) looks at the gross inflows and gross outflows separately.

The results are largely in line with the existing EMP literature. Within external fac- tors, world interest rate is insignificant while VIX is significant in explaining higher EMP. This may be that US interest rate itself tends to be policy responses to the US economic and monetary conditions, but is not directly indicative of the market responses, and thus may be too noisy to be informative. On the other hand, VIX is commonly viewed as a transmission channel of US monetary spillover effect (Rey 2015). It proxies for global risk aversion or market fear, and it also directly influences bank's leverage decision through bank's Value-at-Risk (Bruno and Shin 2015). Thus, a rise in VIX represents a rise in market fear or global financial volatility, which may then lead to capital withdrawals from the EMEs, hence increase currency pressure faced by the country. Within domestic factors, lower GDP growth, trade balance, and stock market returns are associated with greater EMP. Further, a large body of EMP literature has pointed out the importance of domestic credit in driving up the EMP. For instance, Van Poeck et al. (2007) find that credit growth is one of the leading contributors to the EMP for the eight EU members. Aizenman and Binici (2016) find marginally significant association between domestic credit and EMP for the EMEs. In the emerging countries, domestic credit expansion tends to be excessive during booms and retrench strongly during troughs. This study confirms that domestic credit, being a proxy for monetary condition, is important in determining the EMP. Finally, all types of capital outflows (inflows) are found to have significant and positive (negative) relationship with EMP.

Tables 5 and 6 document the estimation results for both the multinomial logit and probit models, respectively, which investigate the predictors of extreme EMP events. We will mainly discuss the results from our baseline logit model, and the probit regression results are included as one of the sensitivity checks.

Table 5 Multinomial logit model

Variables	(1a) Negative	(1b) Positive	(2a) Negative	(2b) Positive	(3a) Negative	(3b) Positive
Constant	−3.280***	−2.547***	−3.321***	−2.520***	−3.200***	−2.480***
	(0.190)	(0.143)	(0.195)	(0.143)	(0.195)	(0.146)
L.World Interest Rate (%Δ)	−0.027	0.037	−0.035	0.042	−0.022	0.037
	(0.030)	(0.040)	(0.030)	(0.040)	(0.031)	(0.040)
VIX (%Δ)	−0.002	0.010***	0.000	0.010***	−0.003	0.009***
	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)
Commodity Term of Trade (%Δ)	0.025	−0.015	0.038	−0.013	0.051	−0.020
	(0.134)	(0.091)	(0.136)	(0.092)	(0.138)	(0.091)
Growth in GDP per capita	0.087***	−0.185***	0.091***	−0.184***	0.088***	−0.181***
	(0.022)	(0.018)	(0.023)	(0.018)	(0.022)	(0.018)
CPI Inflation	0.020***	0.020***	0.020***	0.019***	0.019***	0.019***
	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)
Trade Balance (%GDP)	0.024*	−0.018	0.030**	−0.020	0.028*	−0.016
	(0.014)	(0.012)	(0.015)	(0.012)	(0.015)	(0.012)
Stock Market Returns	0.028***	−0.039***	0.031***	−0.039***	0.028***	−0.037***
	(0.009)	(0.007)	(0.009)	(0.007)	(0.009)	(0.007)
Change in Credit (%GDP)	−0.084***	0.028***	−0.090***	0.028***	−0.082***	0.028***
	(0.015)	(0.010)	(0.016)	(0.010)	(0.015)	(0.010)
Net Portfolio Outflows (%GDP)	−0.189***	0.089***				
	(0.030)	(0.027)				
Portfolio Equity (%GDP)			−0.213***	0.078		
			(0.063)	(0.051)		
Portfolio Debt (%GDP)			−0.170***	0.100***		
			(0.034)	(0.032)		
Net Direct Outflows (%GDP)	−0.009	0.024	−0.015	0.029		
	(0.030)	(0.032)	(0.030)	(0.033)		
Net Other Outflows (%GDP)	−0.156***	0.075***	−0.162***	0.077***		
	(0.024)	(0.020)	(0.025)	(0.020)		
Gross Portfolio Outflows (%GDP)					−0.308***	−0.022
					(0.077)	(0.055)
Gross Portfolio Inflows (%GDP)					0.177***	−0.123***
					(0.032)	(0.032)
Gross Direct Outflows (%GDP)					−0.019	0.012
					(0.032)	(0.035)
Gross Direct Inflows (%GDP)					0.013	−0.011
					(0.030)	(0.033)
Gross Other Outflows (%GDP)					−0.162***	0.073**

Table 5 (continued)

Variables	(1a) Negative	(1b) Positive	(2a) Negative	(2b) Positive	(3a) Negative	(3b) Positive
					(0.039)	(0.031)
Gross Other Inflows (%GDP)					0.155***	−0.074***
					(0.026)	(0.023)
Pseudo R^2	0.251	0.251	0.255	0.255	0.255	0.255
Observations	1,800	1,800	1,777	1,777	1,800	1,800

Standard errors in parentheses. *, **, and *** denote significance at 10, 5 and 1% level

5.2.1 Multinomial Logit Regression Results

Focusing on the extreme EMP episodes, which are essentially tail observations of EMP distribution, a number of interesting results stand out as compared to the linear regression results:

First, VIX is a significant determinant for currency crises but insignificant for extreme appreciation episodes. This may imply that the foreign exchange markets of EMEs are more sensitive to higher volatility during bad time than they are to lower volatility during good time, indicating asymmetric risk aversion of investors.

Second, while trade balance is a significant regressor for EMP in Table 4, the correlation is marginal when we consider only extreme EMP events. Trade balance is only significant in explaining extreme appreciation pressure at 10% level in Specifications (1a) and (3a), and 5% level in Specification (2a).

Third, turning to net capital flows, Specifications (1a) and (1b) show that both the portfolio and other outflows (inflows) are associated with higher probability of extreme positive (negative) event. This is consistent with the expectation that FDI is more resilient and stable comparing to other types of capital flows, whereas short- term portfolio and credit flows are more prone to market sentiment and speculative motive, in which their trend could be quickly reversible and thus amplify financial market volatility. In Specifications (2a) and (2b), portfolio equity is significant in explaining extreme negative (appreciation) event but not for extreme positive event. Portfolio debt is significant in explaining both extreme outcomes. Some existing studies provide evidence that portfolio debt tends to be more harmful than equity, since debt securities imply fixed obligations for the borrower which offer limited risk sharing with the creditor (Ostry et al. 2010). Debt deleveraging is also more rampant during the time of financial frailty. Aizenman et al. (2012) find debt deleveraging pressure to be the main force behind emerging markets' EMP increase during the GFC period.

Forth, distinguishing the residency of flows, both gross inflows and gross out- flows are significantly correlated with extreme negative event, with larger coefficient found for gross outflows. Put differently, comparing to the surge in capital inflows by nonresidents, the retrenchment of capital outflows by the residents plays a more dominant role during large appreciation events. On the other hand, as pointed out by Rey (2015), asset markets are more sensitive to global financial cycle in the countries with large credit inflows. This finding could be extended to foreign exchange markets, since gross portfolio inflows and gross credit inflows are two major contributors to the currency crises episodes, with (slightly) larger coefficient found for credit inflows. This implies that currency crises are closely linked to the sudden stop of short term inflows by foreign investors.

5.3 Robustness Tests

We perform robustness tests by considering (1) multinomial probit model as the alternative regression method to logit model; (2) extension of baseline model by including additional variables, such as dummy of floating currency regime, reserve holding and capital control variables. To save space, we only report results for the variables of interest in this section. All results are based on Eq. 2 with gross capital flows specification, unless otherwise stated.

5.3.1 Multinomial Probit Regression Results

As probit regression commonly produces lower coefficient values than that of logit regression, comparisons should be made based on the signs and statistical significance of the variables. Overall, the qualitative results and implications of probit model are similar to the baseline results, both in terms of the level of pseudo R2 and coefficient signs of explanatory variables. Stock market returns become significant at 5% level in Specifications (1a), (2a) and (3a) in Table 6 from 1% level in Table 5.

5.3.2 Floating Currency Regime

To evaluate whether countries with floating currency regime face different likelihood of foreign exchange turbulence compared to countries with non-floating regime, we include a dummy variable float compiled from IMF AREAER database on annual frequency. We report estimated coefficients of two variables that are of central interest, namely float and VIX, as the latter is a popular indicator to measure susceptibility of an economy towards global financial cycle. Table 7 Column1 shows that, controlling for float dummy does not seem to reduce incidence of currency crisis, and VIX remains statistically significant at 1% level. However, countries with floating currency regime does seem to face lower likelihood of excessive appreciation pressure.

Table 6 Multinomial probit model

Variables	(1a) Negative	(1b) Positive	(2a) Negative	(2b) Positive	(3a) Negative	(3b) Positive
Constant	−2.395***	−1.978***	−2.429***	−1.964***	−2.335***	−1.921***
	(0.120)	(0.100)	(0.124)	(0.100)	(0.124)	(0.102)
L.World Interest Rate (%Δ)	−0.025	0.019	−0.032	0.023	−0.022	0.022
	(0.021)	(0.028)	(0.022)	(0.028)	(0.022)	(0.028)
VIX (%Δ)	0.000	0.007***	0.002	0.007***	0.000	0.006***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Commodity Term of Trade (%Δ)	0.005	−0.011	0.016	−0.009	0.024	−0.017
	(0.094)	(0.067)	(0.096)	(0.068)	(0.097)	(0.068)
Growth in GDP per capita	0.051***	−0.133***	0.055***	−0.133***	0.052***	−0.131***
	(0.015)	(0.013)	(0.015)	(0.013)	(0.015)	(0.013)
CPI Inflation	0.017***	0.017***	0.017***	0.016***	0.016***	0.016***
	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Trade Balance (%GDP)	0.017*	−0.012	0.021**	−0.013	0.020*	−0.010
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
Stock Market Returns	0.013**	−0.026***	0.015**	−0.027***	0.014**	−0.025***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
Change in Credit (%GDP)	−0.055***	0.021***	−0.059***	0.021***	−0.054***	0.020***
	(0.010)	(0.008)	(0.011)	(0.008)	(0.010)	(0.008)
Net Portfolio Outflows (%GDP)	−0.128***	0.069***				
	(0.022)	(0.020)				
Portfolio Equity (%GDP)			−0.138***	0.047		
			(0.045)	(0.038)		
Portfolio Debt (%GDP)			−0.114***	0.082***		
			(0.024)	(0.023)		
Net Direct Outflows (%GDP)	−0.009	0.017	−0.013	0.021		
	(0.022)	(0.022)	(0.022)	(0.023)		
Net Other Outflows (%GDP)	−0.098***	0.045***	−0.103***	0.047***		
	(0.017)	(0.014)	(0.017)	(0.014)		
Gross Portfolio Outflows (%GDP)					−0.211***	−0.022
					(0.054)	(0.040)
Gross Portfolio Inflows (%GDP)					0.118***	−0.097***
					(0.023)	(0.023)
Gross Direct Outflows (%GDP)					−0.018	0.006
					(0.023)	(0.024)
Gross Direct Inflows (%GDP)					0.013	−0.007
					(0.022)	(0.023)
Gross Other Outflows (%GDP)					−0.108***	0.045**
					(0.028)	(0.022)

Table 6 (continued)

Variables	(1a) Negative	(1b) Positive	(2a) Negative	(2b) Positive	(3a) Negative	(3b) Positive
Gross Other Inflows (%GDP)					0.096***	−0.046***
					(0.018)	(0.016)
Pseudo R^2	0.247	0.247	0.251	0.251	0.252	0.252
Observations	1,800	1,800	1,777	1,777	1,800	1,800

Standard errors in parentheses. *, **, and *** denote significance at 10, 5 and 1% level

5.3.3 Reserve Holding

Next, we assess whether adequacy of reserve holding may shield countries from extreme EMP events. We compute ratio of international reserves to GDP, and this variable is entered as 1-quarter lag to reduce simultaneity bias given that EMP con- sists of change of international reserve as one of its components. We find that while higher reserve holdings have negative correlation with extreme EMP events in the next quarter, such relationship is only significant for negative EMP episodes. We further examine interactive term between reserve holdings and VIX, which we find reserves holdings turn slightly significant at 10% level in reducing extreme positive event, but such effectiveness is partially offset for countries with higher VIX. Another way to interpret this is countries with higher reserve holdings are also economies that tend to be more open,[16] hence sensitivity to global financial cycle is also more prevalent for these economies.

5.3.4 Capital Control

To evaluate effect of capital control, we consider two data sets. One is Chinn-Ito index (KAOPEN), which is an index measuring a country's degree of de jure capital account openness (Chinn and Ito 2006). The other one is a set of capital control measures constructed by Ferna´ndez et al. (2016), which covers capital control on both inflows and outflows for the extensive asset categories. We consider overall restriction index (KA), overall inflow restriction index (KAI) and overall outflow restriction index (KAO) from this data set. Again, to avoid simultaneity problem, we take lagged values for these variables. However, as the financial openness index or capital control measures are only available in annual frequency, one-year (i.e. 4-quarter) instead of one-quarter lag is implemented. As shown from Table 8, higher capital account openness and lower capital control are found to significantly reduce probability of large appreciation pressure. Looking at segregated capital control measures, it shows that control on capital outflows significantly attenuates probability of currency crises at 1% level. This signifies that while capital inflow liberalization is associated with lower extreme

[16] Correlation between reserve to GDP ratio and Chinn-Ito financial openness index is 0.14 at 1% significance level.

events, control on capital outflow can be utilized to prevent 'Sudden Stop' of capital flows, hence reducing chance of large depreciation pressure.

Table 7 Assessing floating currency regime and reserve holding on extreme EMP

Variables	(1a) Negative	(1b) Positive	(2a) Negative	(2b) Positive	(3a) Negative	(3b) Positive
VIX (%Δ)	−0.003	0.009***	−0.004	0.010***	−0.008	−0.003
	(0.004)	(0.003)	(0.004)	(0.003)	(0.008)	(0.562)
Float	−0.716***	0.348				
	(0.235)	(0.236)				
L.Reserve (%GDP)			−0.013***	−0.002	−0.013***	−0.004*
			(0.003)	(0.384)	(0.003)	(0.003)
L.Reserve · VIX					0.0001	0.0002***
					(0.0001)	(0.0001)
R^2	0.260	0.260	0.268	0.268	0.272	0.272
Observations	1,800	1,800	1,788	1,788	1,788	1,788

Standard errors in parentheses. *, **, and *** denote significance at 10, 5 and 1% level

Table 8 Assessing capital control measures on extreme EMP

Variables	(1a) Negative	(1b) Positive	(2a) Negative	(2b) Positive	(3a) Negative	(3b) Positive
VIX (%Δ)	−0.004	0.010***	−0.009*	0.012***		0.013***
	(0.367)	(0.003)		(0.003)		(0.003)
KAOPEN (1-year-lag)	−1.584***	0.311				
	(0.418)	(0.306)				
KA (1-year-lag)			1.677***	−0.345		
			(0.453)	(0.328)		
KAI (1-year-lag)					2.245***	0.743*
					(0.507)	(0.400)
KAO (1-year-lag)					−0.742	−1.195***
					(0.490)	(0.375)
R^2	0.269	0.269	0.292	0.292	0.301	0.301
Observations	1,762	1,762	1,674	1,674	1,674	1,674

Standard errors in parentheses. *, **, and *** denote significance at 10, 5 and 1% level

Table 9 Splitting sample by median of capital control

Variables	Low Capital Control (1a) Negative	(1b) Positive	High Capital Control (2a) Negative	(2b) Positive
Constant	−3.590***	−2.182***	−3.185***	−2.869***
	(0.320)	(0.200)	(0.291)	(0.229)
L.World Interest Rate (%Δ)	0.067	-0.058	-0.058	-0.052
	(0.069)	(0.050)	(0.059)	(0.044)
VIX (%Δ)	0.001	0.011***	-0.005	0.008*
	(0.007)	(0.004)	(0.006)	(0.004)
Commodity Term of Trade (%Δ)	0.206	-0.004	-0.119	-0.056
	(0.189)	(0.148)	(0.203)	(0.143)
Growth in GDP per capita	0.139***	−0.200***	0.044	−0.164***
	(0.034)	(0.028)	(0.036)	(0.027)
CPI Inflation	0.004	−0.029**	0.043***	0.053***
	(0.010)	(0.012)	(0.011)	(0.010)
Trade Balance (%GDP)	0.050*	−0.056**	0.029	-0.014
	(0.028)	(0.023)	(0.018)	(0.016)
Stock Market Returns	0.044***	−0.026**	0.014	−0.039***
	(0.013)	(0.012)	(0.013)	(0.011)
Change in Credit (%GDP)	−0.087***	0.058***	−0.087***	0.027*
	(0.022)	(0.015)	(0.024)	(0.016)
Gross Portfolio Outflows (%GDP)	−0.326***	−0.080	−0.309**	0.136
	(0.101)	(0.071)	(0.138)	(0.090)
Gross Portfolio Inflows (%GDP)	0.131**	−0.166***	0.259***	−0.100**
	(0.051)	(0.047)	(0.048)	(0.045)
Gross Direct Outflows (%GDP)	-0.068	0.062	−0.026	0.036
	(0.044)	(0.046)	(0.079)	(0.061)
Gross Direct Inflows (%GDP)	0.032	−0.062	0.034	−0.040
	(0.040)	(0.045)	(0.075)	(0.059)
Gross Other Outflows (%GDP)	−0.178***	0.106**	−0.167***	0.061
	(0.062)	(0.044)	(0.056)	(0.047)
Gross Other Inflows (%GDP)	0.141***	−0.074**	0.192***	−0.083**
	(0.039)	(0.032)	(0.045)	(0.036)
Pseudo R^2	0.341	0.341	0.259	0.259
Observations	918	918	890	890

Standard errors in parentheses. *, **, and *** denote significance at 10, 5 and 1% level

To lessen issue of mismatched frequency, we further examine role of capital control by splitting our sample based on median of KA. Table 9 shows multinomial logit regression results for low and high capital control groups. The results of extreme negative EMP between two samples are not vastly different, but there is a stark difference for extreme positive EMP. High capital control group does appear to have weaker responses to VIX, trade openness, domestic credit growth and gross portfolio inflows.

6 Conclusion

The goal of this paper is to develop a deeper understanding on the foreign exchange turbulence in the emerging market economies. This study conducts a comparative analysis between extreme negative and positive EMP episodes for 21 emerging countries over the period from 1995Q1 to 2019Q4, with particular interest placed on the roles played by international capital flows.

To distinguish large fluctuations from normal observations, we employ identification method based on EVT to deal with asymmetry and heavy-tailedness of actual EMP distribution. We find heterogeneity in tail indices across different countries' EMP data and there exists asymmetry on both sides of EMP distribution with greater number of extreme positive episodes found for most countries.

Comparing results for continuous EMP index under linear regression to that for extreme EMP events under logit/probit model, we find that variables such as trade balance and direct investment flows are significant in explaining EMP, but such influences are marginal or insignificant when we only consider extreme circumstances. Moreover, predictors between extreme appreciation and depreciation pressures are not exactly the same. Most notably, market fear (as proxied by VIX) is a significant indicator for currency crises but not for extreme appreciation events, whereas trade balance is significant independent variable for abrupt appreciation but not for the opposite case.

For implications of capital control policy, among different de facto capital flows channels, the most problematic flows that need special attention are the portfolio and credit flows. By differentiating the residency of flows, it is found that while both inflows and outflows are significantly correlated with extreme negative episodes, gross outflows as driven by the residents have slightly greater coefficients. In contrast, extreme positive episodes are mainly associated with gross inflows as driven by foreign investors, especially through the form of credit inflows. Leveraging capital control measures compiled by Ferna´ndez et al. (2016), we find that inflow control and outflow control each exhibits different effectiveness in reducing occurrence of different types of extreme events. While capital account liberalization is associated with lower probability of extreme appreciation events, control on capital outflows can be a complementary policy to prevent capital flight (particularly sudden reversal of capital inflows driven by foreign investors) and thus reduce chance of currency crisis. In a nutshell, this study sheds light on the proximate determinants of extreme EMP events, but the regression results should be interpreted with care, as the significant coefficients do not imply causal relationships. Establishing the causal linkage between EMP and capital flows will be desirable in future research in order to provide further insights for capital control policy.

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Appendix

Table 10 List of emerging market economies

Emerging Asia (8)	Latin America (6)	Emerging Europe (7)
India	Argentina	Bulgaria
Indonesia	Brazil	Czech Republic
Korea	Chile	Hungary
Malaysia	Colombia	Poland
Pakistan	Mexico	Romania
Philippines	Peru	Russia
Sri Lanka		Turkey
Thailand		

Table 11 Description of variables

Variables	Description
L.World interest rate (%Δ)	Change in U.S. interest rates, one-quarter-lag
VIX (%Δ)	Change in log of CBOE S&P 500 Options Implied Volatility Index
Commodity terms of trade (%Δ)	Change in log of commodity terms of trade index (Gruss and Kebhaj 2019)
Growth in GDP per capita	Change in Gross Domestic Product per capita
CPI inflation	Annual inflation computed using Consumer Price Index
Trade balance (%GDP)	Difference between exports and imports, % GDP
Stock market returns	Change in the log of equity price index
Change in Credit (%GDP)	Change in domestic claims, % GDP
Net Portfolio Outflows (%GDP)	Portfolio investment; assets (market value, flow) minus liabilities to nonresidents (market value, flow), % GDP
Portfolio Equity (%GDP)	Portfolio equity securities; assets (market value, flow) minus liabilities to nonresidents (market value, flow), % GDP
Portfolio Debt (%GDP)	Portfolio debt securities; assets (market value, flow) minus liabilities to nonresidents (market value, flow), % GDP
Net Direct Outflows (%GDP)	Direct investment; assets (market value, flow) minus liabilities to nonresidents (market value, flow), % GDP
Net Other Outflows (%GDP)	Other investment; assets (market value, flow) minus liabilities to nonresidents (market value, flow), % GDP
Gross Portfolio Outflows (%GDP)	Portfolio investment; assets (market value, flow), % GDP
Gross Portfolio Inflows (%GDP)	Portfolio investment; liabilities (market value, flow), % GDP
Gross Direct Outflows (%GDP)	Direct investment; assets (market value, flow), % GDP
Gross Direct Inflows (%GDP)	Direct investment; liabilities (market value, flow), % GDP
Gross Other Outflows (%GDP)	Other investment; assets (market value, flow), % GDP
Gross Other Inflows (%GDP)	Other investment; liabilities (market value, flow), % GDP
Float	Dummy = 1 if the country adopts floating currency and = 0 otherwise
L.Reserve (%GDP)	International reserve (excluding gold), % GDP, one-quarter-lag
KAOPEN (1-year-lag)	Chinn-Ito financial openness index, 4-quarter-lag
KA (1-year-lag)	Overall restrictions index (all asset categories), 4-quarter-lag
KAI (1-year-lag)	Overall inflow restrictions index (all asset categories), 4-quarter-lag
KAO (1-year-lag)	Overall outflow restrictions index (all asset categories), 4-quarter-lag

Quarterly data are collected from International Financial Statistics (IFS) and CEIC database

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