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What happens to emerging market economies when US yields go up?*

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Abstract

This paper explores why some episodes of US yield increases result in investor retrenchment from emerging markets and others do not. To answer this, we identify episodes of sharp increases in US 10-year Treasury yields and explore under which conditions these are associated with negative outcomes in emerging markets. We focus on four outcome variables: local currency yields, exchange rates, equity prices, and portfolio fund flows. We find that increases in US yields are more likely to be associated with adverse outcomes in emerging markets when they reflect (i) a rise in the US term premium, (ii) coincide with dollar appreciation, and (iii) rising inflation expectations in the US and in EMEs. The effects of these variables are highly non-linear and economically significant as well as robust to a variety of sensitivity checks.

Keywords: monetary policy; international spillovers; term premium; US dollar
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1 Introduction

What happens to emerging market economies (EMEs) when US yields go up? This is a recurrent question in policy-making circles whenever US yields increase. The financial press then gets inundated with headlines such as "The Bernanke panic",[1] "EM currencies on the ropes as 10-year bond yield tops 3.1%",[2] "Which emerging markets are most exposed to a Treasury tantrum?".[3]

Experience in the last two decades, however, tells us that sharp increases in US yields can have very different effects on EMEs. At one end of the spectrum, the 2013 taper tantrum resulted in a significant retrenchment of investors from EME assets, leading to sharp depreciations of exchange rates, drops in asset prices and large capital outflows. But in many other cases, spillovers were

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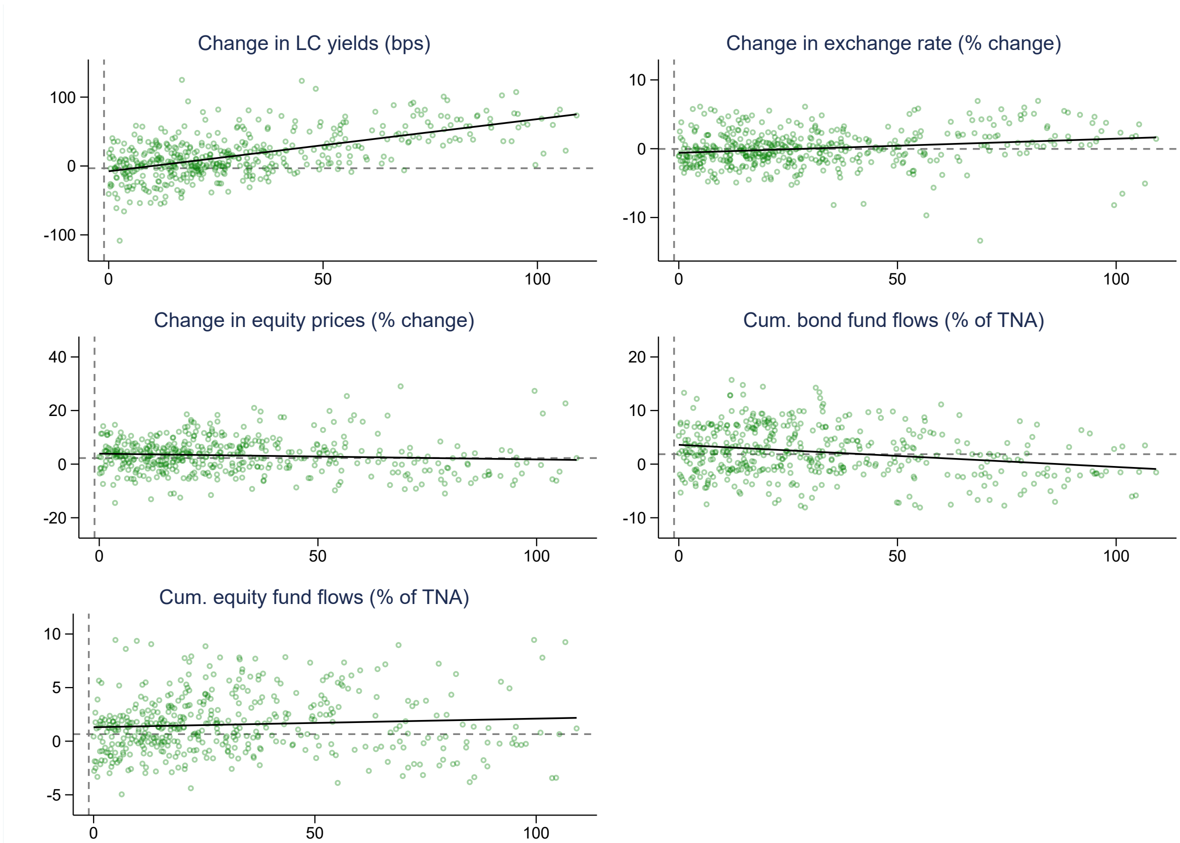
[1] CNN Money, June 8, 2006.
[2] Financial Times, May 17, 2018.
[3] The Economist, Mar 4, 2021

negligible. In fact, most increases in US yields between 2004 and 2022 were not associated with negative outcomes in EMEs (Figure 1).

Figure 1: What happens to EMEs when US yields go up?



This figure shows scatter plots of 12-week changes in US Ten-year sovereign yields (x-axis) and changes in four outcomes in EMEs in the same period (y-axis): local currency yields, nominal exchange rates against the USD, equity prices and portfolio fund flows (the latter split into bond and equity fund flows). Cumulative fund flows over a 12-weeks period are expressed as percentage of total net assets at the beginning of the period. In all cases, changes are computed with country data and aggregated by computing the median change across 17 EMEs (detailed in Section 2.1).

This paper explores the reasons behind these differences. We start by identifying all episodes of rapid increases in US 10-year Treasury yields between January 2004 and June 2022. This gives us 30 episodes, which we term "yield spikes" and which form the basis of our analysis. We then analyse how financial conditions in a sample of 17 major EMEs changed during these episodes. We look at four outcomes in EMEs: (i) local currency (LC) yields, (ii) bilateral nominal exchange rates against the US dollar (FX), (iii) equity prices (domestic stock market index), and (iv) portfolio fund flows, which we split into bonds and equity. For each of these outcomes, we compute the start to peak change during each yield spike.

In the main part of our analysis, we relate each of these outcome variables to a large set of possible drivers. We group these into five categories: (i) characteristics of the yield spike itself, (ii) changes in global financial conditions and risk appetite, (iii) changes in US financial conditions during the yield spike, (iv) US macroeconomic conditions at the start of the yield spike, and (v) domestic conditions in EMEs, including indicators for financial imbalances and for macroeconomic fundamentals. We have a total of 28 explanatory variables. To allay concerns about inference with a reduced number of degrees of freedom, we employ recently-developed covariate selection techniques from the machine learning literature that are specifically designed for making valid inference in settings with a high number of covariates. We complement this analysis by combining the outcome variables into a single measure for the severity of EM outcomes: the number of variables with realisations in the (adverse) tail of the distribution ("co-exceedances"). We model the count of joint negative realisations (ie the number of co-exceedances) via a multinomial logistic approach.

Our key findings are as follows:

1. Two developments in particular increase the odds of an US yield increase spilling over into EMEs: increases in the US term premium[4] and appreciations of the US dollar against a broad basket of currencies. The estimated effects of these variables are economically significant. A 100 basis points (bps) increase in the US term premium is correlated with an increase in LC yields of about 115 bps, a 6 percent EM currency depreciation, a fall in domestic equity prices of about 5 percent, and bond and equity funds outflows of up to 8 percent of net total assets at the onset of the spike. Similarly, a 10 percent appreciation of the US broad dollar index is associated with a currency depreciation in EMEs of about 8 percent and a similarly-sized fall in equity prices. The prominent role of the US term premium could reflect unconventional monetary policy having a particularly large impact on EMEs, increasing risk perceptions of global investors (see eg Kalemli-Ozcan (2019)) or increasing term premia in EMEs themselves (see eg Albagli, Ceballos, Claro and Romero (2019)), or a combination of all these or another not-yet identified mechanism. The prominent role of the US dollar exchange rate in explaining financial conditions in EMEs is well understood as reflecting the risk-taking channel of the exchange rate (see eg Bruno and Shin (2014, 2015), Avdjiev, Du, Koch and Shin (2019) and Obstfeld and Zhou (2022)).

[4]We base our results on the decomposition of US 10-year Treasury yields of Kim and Wright (2005) and available at the US Federal Reserve Board: www.federalreserve.gov/data/three-factor-nominal-term-structure-model.htm.

2. US macroeconomic conditions also matter. In particular, increases in US inflation expectations in the three months prior to the yield spike are associated with large depreciations and declines in equity prices in EMEs. This is in line with the findings by Hoek, Kamin and Yoldas (2022), Ciminelli, Rogers and Wu (2022) and Arteta, Kamin, Ruch and Ulrich (2022) that US interest rate shocks driven by inflationary concerns have negative spillovers to EMEs. The negative effects of rising inflation expectations during yield spikes in the United States could reflect the tightening of financial conditions in EMEs coupled with weakening US economic activity and subdued investor sentiment.

3. A somewhat puzzling result concerns the role of risk sentiment in global financial markets. One measure of risk and risk-taking in the United States, high-yield corporate bond spreads, show up significantly and with the expected sign in some of the equations. But the most used measure, the VIX, shows up consistently with a positive sign, suggesting that EM currencies, asset prices and fund flows are *stronger* when the VIX increases. While this is at odds with the influential paper by Rey (2015), other recent papers have suggested that the VIX is not a particularly good measure for capturing the risk appetite of investors. For instance, Barras and Malkhozov (2016) argue that changes in the VIX tend to be driven by the balance sheet capacity of banks, which may behave differently than the balance sheet capacity of other investors. The VIX may also be positively correlated with capital flows to EMEs because it is during bad times that EMEs borrow more to smooth out consumption (Avdjiev *et al.* (2019) and Kalemli-Ozcan (2019)). That said, it is already known that the VIX does not explain much of the variation in capital flows across countries (Cerutti, Claessens and Rose (2019)).

4. Interestingly, EM fundamentals, such as international reserves, current account balances, sovereign ratings, and forecasts of GDP growth, seem to matter comparatively little. Only higher levels of domestic inflation came out as robustly associated with worse EME outcomes, and only for currency depreciation.

5. The analysis of joint negative realizations corroborates the factors just mentioned as the key drivers explaining EME negative outcomes across yield spikes, and also shows that these effects are highly non-linear. That is, the likelihood of moving from a bad outcome in one variable to bad outcomes in several variables increases rapidly as the change in the US term premium or appreciation of the dollar steepens.

The statistical significance and magnitude of these effects are robust to changes in the specification. We run a number of robustness checks, including, estimating the model on the cross-section of EM variables, using an alternative algorithm to identify yield spikes, and excluding the yield spikes following the bankruptcy of Lehman Brothers in 2008 and the May 2013 taper tantrum (both episodes that were very large shocks). The results barely change.

The paper contributes to the growing literature on international spillovers of US financial developments.[5] While most papers focus on the impact of US monetary policy shocks, only a relative small number of papers considers the impact of yield increases as we do. Even a smaller number considers how the characteristics of yield increases and the factors driving them affect spillovers, which is the focus of our paper. The studies most related to our work are Curcuru, Kamin, Li and del Giudice-Rodriguez (2018), Mehrotra, Moessner and Shu (2019), Albagli *et al.* (2019), Ahmed, Akinci and Queralto (2021), Hoek *et al.* (2022), Ciminelli *et al.* (2022) and Arteta *et al.* (2022).

After decomposing changes in US long-term yields into expected short-term rates and term premia (or its components),[6] both Curcuru *et al.* (2018) and Mehrotra *et al.* (2019) find that spillovers to EM bond yields tend to be large and stem from all US yield curve components. Interestingly, they also find that the effect in EMEs from changes in rate expectations are more sizeable than those stemming from changes in the term premium or its components (the opposite holds for spillovers to advanced economies). In an event study around FOMC announcement days, Albagli *et al.* (2019) find that spillovers to EMEs work mostly through increasing term premia in EMEs (whereas it is through expectations of future policy rates in the case of advance economies). To the extent that we find spillovers to local currency yields in EMEs from the increase in US yields and its term premia component, our results are in line with these papers, albeit we do not undertake a horse race between the components of US long-term yields, nor explore the possible mechanism by which US term premia increases the odds of negative spillovers to EMEs.

Ahmed *et al.* (2021), Hoek *et al.* (2022), Ciminelli *et al.* (2022) and Arteta *et al.* (2022) explore the heterogeneity of the effects of US interest rate increases as a function of the reasons driving the increase in rates. These papers build on the key insight of Hoek *et al.* (2022) that US interest rate

[5]The literature is huge and recently reviewed by Arteta *et al.* (2022). The literature's key findings are the existence of significant global spillovers of movements in US interest rates, no only to EM interest rates or local-currency yields (Frankel, Schmukler and Serven, 2004; Hofmann and Takáts, 2015; Kalemli-Ozcan, 2019; Kharroubi and Zampolli, 2016; Obstfeld, 2015), but also to yields of foreign-currency denominated EM bonds (Gilchrist, Yue and Zakrajšek, 2019), domestic economic activity (Iacoviello and Navarro, 2019), equity markets (Ehrmann and Fratzscher, 2004), and cross-border lending to EMEs (Bräuning and Ivashina, 2020).

[6]Curcuru *et al.* (2018) decompose changes in US 10-year yields into expected short-term rates and term premia and estimate the effects on EM exchange rates and local currency yields in one-day windows around FOMC announcement days. Mehrotra *et al.* (2019) decompose monthly changes of US 10-year yields into changes in the expected real rate, expected inflation, real risk premium and inflation risk premium, and use monthly data to study the contemporaneous effects of these on EM local currency yields.

increases can be characterised as being driven by growth news shocks or inflationary shocks (including a heightened response of the monetary authority to inflation – a more hawkish stance).[7] These papers find that the spillovers to EMEs driven by inflationary concerns, rather than growth prospects, tend to be larger. This is documented for EM asset prices (Hoek *et al.*, 2022) and investments into EM dedicated mutual funds (Ciminelli *et al.*, 2022) based on event studies around FOMC announcement days. And also on financial, macroeconomic and fiscal indicators using quarterly time series (Arteta *et al.*, 2022). These papers also show that countries with weaker fundamentals are more sensitive to these spillovers, which Ahmed *et al.* (2021) rationalize using a calibrated New Keynesian model with financial frictions and partial dollarization.[8] Our finding that yield spikes with rising US inflation expectations are correlated with more negative spillovers to EMEs are in line with the key point of this recent literature.

Thus, the paper contributes to the literature on international spillovers of US monetary policy not only by documenting spillovers to EM asset prices and capital flows when US long term yields increase sharply, but also by identifying key US, global and EM-specific financial developments associated with such sharp increases that at the same time are correlated with negative outcomes in EMEs. Of particular concern are yield spikes associated with increases in the US term premium, appreciations of the US dollar and rising US and EME inflation expectations.

Our approach differs from the literature in several dimensions. First, we identify yield spike episodes on the basis of US 10-year Treasury yields alone, irrespective of the outcomes for EMEs and of the reasons behind the increase in yields. We also do not constrain the analysis to study the spillovers to EMEs following monetary policy announcements. Second, all estimations are done on the cross-section of these yield spikes. This sets us apart from the literature, which employ either time series regressions or event studies with a (very) short time window around FOMC announcement days. We chose our approach to avoid imposing symmetry or strict linearity assumptions, in which declines in US yields are assumed to affect EMEs in the same way as increases, although with an opposite sign. Furthermore, we precisely match the timing of the increase in yields. This allows us to measure the magnitude and speed of the yield spike much better than if we used evenly-spaced data (fixed time windows).[9] Third, we control for a much larger number of ex-

[7]Following the literature on monetary policy shocks and information effects of central bank communications, Hoek *et al.* (2022) use the co-movement of US 2-year yields and stock prices during one-hour windows following FOMC announcements and employment reports to classify US interest shocks into "monetary" and "growth" shocks.

[8]Related to this, Mehrotra *et al.* (2019) find that spillovers to EMEs tend to be larger when a receiving economy displays greater macro-financial vulnerabilities and this sensitivity is larger for the effect stemming from the inflation risk premia component.

[9]As a consequence, the yield spike episodes in our sample differ in length, ranging from 31 (close to the 30-day

planatory variables than other studies, something made possible by the variable selection method that we employ.

2 Empirical methodology

Our empirical strategy is as follows:

1. We first identify all increases in US yields employing methods used to identify turning points in business cycles but adapted to our purposes. Note that the identification does not depend on how these yield increases impact EMEs or why yields go up. These yield increases – or yield spikes – form the basis of our analysis.

2. For each of the episodes of yield increases, we then compute the changes in LC bond yields, the exchange rate, equity prices and cumulative flows to dedicated EM bond and equity funds. We call these the "outcome variables".

3. We relate these outcomes to a wide range of explanatory variables reflecting the possible reasons behind the increase, characteristics of the yield spike and conditions in EMEs prior to each episode. Since we have a large number of explanatory variables and a fairly limited number of episodes, we use covariate selection techniques from the machine learning literature that are specifically designed to make valid inference in settings with a high number of covariates.

4. We combine the different outcome variables during each episodes into a single measure of the number of co-exceedances – essentially a measure of whether the outcome is in the tail of the distribution – and estimate an ordered Logit model to identify the variables driving the number of co-exceedances during each episode.

The following subsections give more details on these individual steps.

2.1 Identifying yield spikes

We begin our analysis by identifying episodes of increases in US long-term government bond yields using the techniques for business cycle identification of Bry and Boschan (1971) and Harding and Pagan (2002). This requires us to specify simple rules for what constitutes a (local) peak and a (local) trough as well as some censoring rules to restrict the minimal length of any phase (and

minimum imposed by our algorithm) to 246 days.

thus the complete cycle). Specifically, we use the following rules to identify cycles in US 10-year yields obtained from Bloomberg:

1. A series reaches a local peak at time s whenever $y_s > y_{s\pm k}, k = 1, .., K$. A local trough is defined symmetrically as $y_s < y_{s\pm k}, k = 1, .., K$. In our baseline definition we set $K = 30$, so that local peaks and troughs are defined as local maxima/minima during $\pm$ 30-days windows.

2. To eliminate extremely short cycles during periods of great volatility, we set a 30 days minimum distance between peaks and troughs, which gives a minimum length of a cycle of 60 days (ie the number of days between two peaks or two troughs).

3. To avoid having cycles of a very small magnitude, we impose a minimum threshold for the change in yields between peaks and troughs of one standard deviation of the 30-days change in the five years previous to the trough. We use a rolling window since the volatility of the yield series declined over time. To reduce the noise from large day-to-day fluctuations, these 30-days changes are computed over the smoothed series after taking 30-days moving averages.

Our algorithm identifies 30 increases in the yields of 10-years US Treasury notes over the period January 2004–June 2022. We refer to these increases as "yield spikes". Figure A.1 in the Appendix plots the identified yield spikes for the 10-year Treasury. Table A.1 in the Appendix lists the start and end dates of each yield spike, along the observed change in the yield of the 10-year Treasury from start to peak (S2P). Table 1 shows summary statistics of the spikes.

The typical yield spike has a S2P duration of about 100 days and a S2P increase in yields of about 80 bps. However, there is wide variation. Spikes may last for three quarters (246 days) and yields can increase by over 200 bps. The baseline algorithm picks up the most prominent episodes of yield increases in the sample period, for instance the spikes associated to tightening cycles in 2004, 2006, 2016 and 2022. We also identify the spikes following the Bear Stearns bankruptcy in March 2008, the so-called taper tantrum of May 2013, and the market turbulence during the initial stages of the Covid-19 pandemic in the second quarter of 2020.

2.2 EME outcomes

To measure the impact of US yield spikes on EMEs, we obtain data for our four outcome variables: (i) local currency bond yields (LC); (ii) the (nominal) exchange rate against the US dollar (FX);

Table 1: Summary statistics of yield spikes of 10-year Treasury in Jan 2004 – Jun 2022

	N	Mean	Median	Min	Max
Start to peak change in yield (basis points)	30	79.2	66.2	22.8	213.0
Number of days to peak	30	100.9	89.0	31.0	246.0
Speed (basis points per week)	30	6.0	5.6	2.8	13.6

(iii) equity prices (domestic stock market index); (iv) portfolio fund flows, which can be split into bonds and equity. Data on yields, exchange rates and stock prices are daily and from Bloomberg, those on fund flows weekly and from EPFR. For LC yields, we measure S2P changes in basis points and for FX and equity prices S2P changes in percentage points. For fund flows, we compute S2P cumulative flows and express them as percentage of total net assets at the start of the yield spike.

The sample of 17 emerging market economies includes major EMEs without a hard peg to the US dollar: Argentina, Brazil, Chile, China, Colombia, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Thailand, Turkey and South Africa. Data availability on LC yields and weekly portfolio fund flows restricts the analysis to period January 2004–June 2022.

2.3 Explanatory variables

We are interested in identifying the US, global and EM-specific factors affectingg the variation in EME outcomes across-yield spikes. Instead of focusing on a single indicator or a small set of variables, we cast the net wide and include 28 potential drivers of EME outcomes.

We group these potential drivers into five categories:

1. characteristics of the yield spike: the size and speed of the yield increase and an indicator for whether it was primarily driven by changes in inflation expectations;

2. changes in global financial conditions and risk-taking: VIX, US dollar broad index, US 10-year term premium, high-yield corporate spreads and commodity prices;

3. US economic conditions prior and during the yield spike: S2P changes in break-even inflation, equity prices, macroeconomic news surprises during the episode, forecasts for US GDP growth and inflation in the coming 12 months and the revisions in these forecasts in the previous three months;

4. domestic conditions in EMEs: the buildup of financial imbalances, as measured by exchange rate appreciation, cumulative bond and equity flows prior to the episode and changes in

sovereign ratings prior to the yield spike; EM fundamentals, as measured by forecasts for GDP growth and inflation over the coming 12 months, sovereign rating, international reserves, current account balance and changes in policy rates.

All explanatory variables are listed in Table 2. We measure some of the indicators as S2P changes during the yield spike or enter them as starting conditions, using the latest observed value before the start of the spike. For those indicators that have trends, we express starting conditions as the deviation of the 1-year moving average (ma) from the previous 5-year ma mean.[10]

2.4 Modeling outcomes in EMEs across yield spikes

In our baseline specification we estimate variations of the following linear model for each of four outcomes of interest:

$$y_{i,s} = \alpha + \alpha_i + \boldsymbol{\beta}' \boldsymbol{X}_s + \boldsymbol{\Gamma}' \boldsymbol{Z}_{i,s} + \varepsilon_{i,s} \tag{1}$$

where $y_{i,s}$ is the S2P change in the EME outcome of interest for country i during yield spike s. The vector $\boldsymbol{X}_s$ includes 18 yield spike-specific covariates common across EME countries (yield spike characteristics, global and US financial conditions, and US GDP growth and inflation forecasts during the spike and/or their starting conditions). The vector $\boldsymbol{Z}_{i,s}$ includes 10 EME country-specific fundamentals and starting conditions. EMEs time-invariant characteristics are captured by the fixed effect α_i.

While we could estimate equation 1 via standard panel techniques, the large number of explanatory variables and the limited number of yield spikes may raise concerns about over-fitting and valid inference. For each outcome, we need to estimate 45 parameters (17 fixed effects, 28 covariates) on 510 observations (17 EMEs $\times$ 30 yield spikes). While this by itself does not appear to be particularly concerning, we only have a relatively small number of 30 yield spikes to estimate the effects of 18 covariates that vary across yield spikes but not across countries. To allay these concerns we rely on recently-developed covariate selection techniques from the machine learning literature that are specifically designed to make valid inference in settings with a high number of covariates relative to observations (ie a high-dimensional model, in econometrics jargon). We employ the Double-Step LASSO estimator (DS LASSO, for short) of Belloni, Chen, Chernozhukov

[10]Risk-on/risk-off proxies are computed as the difference between the average value of the variable (VIX index or US dollar broad index) in the year previous to the spike with the average value of the previous five years. In the case of the VIX index, a negative value of this difference indicates a risk-on environment, with lower than average international risk aversion as proxied by the VIX index and we additionally include their start to peak changes.

and Hansen (2012), Belloni, Chernozhukov and Hansen (2014), Belloni, Chernozhukov, Hansen and Kozbur (2016). The DS LASSO estimator serves to identify the covariates that are the most relevant and obtain valid inference on them, while being robust to omitted variable bias. DS LASSO can handle models with a very large number of control variables, even exceeding the number of observations.

Table 2: Potential determinants of EME outcomes during US yield spikes

Indicator group	Indicator	Start-to-peak during yield spike	Starting conditions
Yield spike	Size of 10-Y yield change	S2P change (ratio to sd of 30-day changes)	
	Speed of yield increase	S2P bps per week	
	Real yield/Inflation expectations yield spike	Dummy (1 if BEIR driven)	
Global financial conditions	VIX index	S2P % change (units)	1-year ma deviation at start
	USD Broad index FED	S2P change (% change)	1-year ma deviation at start
	US term premium 10Y	S2P change (bps)	1-year ma deviation at start
	US HY corporate spread	S2P change (bps)	
	Commodity prices index	S2P change (units)	
US financial conditions	US Breakeven inflation 5y	S2P change (bps)	
	US Equity market (S&P 500)	S2P % change	
	Citi's macro surprise index	S2P cumulative (units)	
US GDP growth and inflation	US GDP growth forecast (one-year ahead)		3-month MA (at start)
	US Inflation forecast (one-year ahead)		3-month MA (at start)
	US GDP growth forecast (one-year ahead)		Change w.r.t t-3 (pps)
	US Inflation forecast (one-year ahead)		Change w.r.t t-3 (pps)
EME conditions and fundamentals	Policy rate S2P change	Policy rate S2P change (bps)	
	Change in nominal XR 1-year before		% change w.r.t t-12 of monthly MA
	Cumulative bond fund flows 1-year before		Cum. Bond fund flows as % of TNA
	Cumulative equity fund flows 1-year before		Cum. Equity fund flows as % of TNA
	Change in S&P LC rating		Indicator for change in S&P LC rating in last year
	GDP growth		One-year ahead GDP growth forecast (3-m ma)
	Inflation		One-year ahead inflation forecast (3-m ma)
	S&P sovereign rating		S&P rating local currency (increasing in quality)
	Reserves		Reserves to GDP (3-m ma)
	Current account		Current account balance (3-m ma)

The DS LASSO estimator involves two steps. In the first step, we regress the dependent variable $y_{i,s}$ on the full set of explanatory variables. The LASSO estimator drops variables that do not have sufficient predictive power for $y_{i,s}$.[11] In the second step, to avoid biases owing to omitted variables, we run separate LASSO estimations for each explanatory variable $d_{i,s}$ on all other explanatory variables. We thus identify all variables that are highly correlated with the explanatory variable in question and therefore could be confounding factors that need to be included in the final regression.

Note that LASSO is only used for variable selection, not for inference, since it focuses only on predictive power and does not yield standard errors. We obtain inference by running separate regressions of $y_{i,s}$ on $d_{.,s}$, using all the variables that turn out to be significant in step one or step two of the LASSO regressions. This gives us a coefficient and standard errors for each $d_{.,s}$ that can be used for inference.[12]

2.5 Modeling the joint occurrence of negative outcomes in EMEs across yield spikes

Estimating equation 1 gives an estimate of the drivers of negative outcomes during US yield spikes separately for each of our outcomes of interest: local currency yields, exchange rates, equity prices and portfolio fund flows. We complement this analysis with an approach that integrates into one metric the occurrence of negative outcomes in any of these variables (to avoid over-weighting fund flows we merge bond and equity flows into a single aggregate).

To this end, we first define as an "exceedance" an extreme negative realization of each of our outcomes of interest during a US yield spike.[13] "Co-exceedances" then refers to the number of exceedances in any given country or, depending on the context, in our sample as a whole. We then estimate which variables increase the likelihood of a US yield spike resulting in a larger number of extreme negative outcomes in EMEs using a multinomial ordered logit model.

Specifically, we estimate a multinominal ordered logit model in which the probability of observing k number of extreme outcomes in country i in yield spike s, denoted by $y_{i,s}$, is a function

[11] Least Absolute Shrinkage and Selection Operator (LASSO) is a technique that chooses coefficients of a multivariate model by minimising the sum of the squared residuals plus a penalty term that penalizes the size of the model through the sum of absolute values of the coefficients. The estimator of Belloni *et al.* (2012, 2014) selects an optimal penalty term based on the data.

[12] (Belloni *et al.* (2016) provide formal conditions under which their procedure leads to valid inference in panel data, even allowing for selection mistakes, and provide simulation evidence that their procedure works across a wide variety of linear models, including applications akin to this paper with continuous covariates and a clustered covariance structure. We refer the reader to the cited papers for a more detailed treatment of the Double-Step LASSO technique. We implement the DS LASSO estimator employing the command `DSREGRESS` available in Stata, release 17.

[13] The definition of an exceedance in each outcome of interest is spelled out in Section 3.3.

of covariates $\boldsymbol{X}_s$ and $\boldsymbol{Z}_{i,s}$, which are specified as before. This probability can be expressed as:

$$Pr(y_{i,s} > k|\boldsymbol{\kappa}, \boldsymbol{X}_s, \boldsymbol{Z}_{i,s}, \nu_i) = H(\boldsymbol{\beta}'\boldsymbol{X}_s + \boldsymbol{\Gamma}'\boldsymbol{Z}_{i,s} + \nu_i - \kappa_k) \quad (2)$$

where $\boldsymbol{\kappa}$ is a set of cutpoints for the number of K possible co-exceedances and $H(\bullet)$ is the logistic cumulative distribution function. ν_i are country intercepts, which are modeled as random effects assuming they are independent and identically distributed with variance σ_ν^2. The model can be estimated via maximum likelihood.

Based on equation 2, we get an estimate of how the probability of observing a higher number of co-exceedances is affected by our 28 covariates of interest in $\boldsymbol{X}_s$ and $\boldsymbol{Z}_{i,s}$. As in a linear regression model, these estimates are evaluated at the means of the regressors. However, because the probabilities are non-linear functions of the regressors, these estimates give an incomplete picture of the impact of changes in a given covariate. Thus, to interpret the effect of the estimated coefficients, we follow Bae, Karolyi and Stulz (2000) to compute the sensitivity of the probability estimates to the full range of values associated with different key covariates of interest and use plots to illustrate the changes in the implied probabilities of observing a different number of co-exceedances.[14]

The same concerns about valid inference, overfitting and omitted variable bias described in Section 2.3 apply here as well. Unfortunately, owing to the non-linear nature of the model we cannot use DS LASSO here. We therefore proceed in six steps shown in the six columns of Table 4.[15]

Instead, we proceed as follows:

1. we first estimate bivariate regressions for each covariate separately (column 1),
2. we then do the opposite and include all covariates in a single regression (column 2),
3. we then estimate the model including only the covariates common across all countries (column 3),
4. and only country-specific covariates (column 4),
5. we then estimate a model using only those variables that were statistically significant at the 5 percent confidence level in columns 2 and either 3 and 4 (column 5),

[14] We estimate the multinominal ordered logit model employing the command `XTOLOGIT` available in Stata, release 17.

[15] To reduce clutter, the table only shows the estimated coefficients. Their statistical significance is indicated by stars, with superscripts "$**$" and "$***$" denoting significance at 5 and 1 percent levels, respectively. The full set of results with the estimated standard errors is available upon request.

6. finally, in order to get a parsimonious model we drop all covariates that are insignificant at the 5 percent level in that exercise and estimate the model with the remaining (statistically significant) covariates (column 6).

3 What happens to EMEs when US yields go up?

3.1 Non-parametric analysis

US yield spikes can have widely different effects on EMEs. As Figure 2 shows, EM local currency yields go up during most US yield spikes, but not during all. And even if they do go up, they tend to increase less than one-for-one compared to the rise in US yields (Figure 3). Only three out of the thirty yield spikes in our sample feature a median change in LC yields larger than the change in US yields (ie blue diamonds above the horizontal dark orange markers). There is also no clear-cut relationship between the size of the US yield spike and the increase in EM LC yields.

The results for the other outcome variables are similar: Figure A.2 in the Appendix does not show any clear relationship between the size of the US yield increase and EM exchange rates, equity prices and portfolio fund flows.

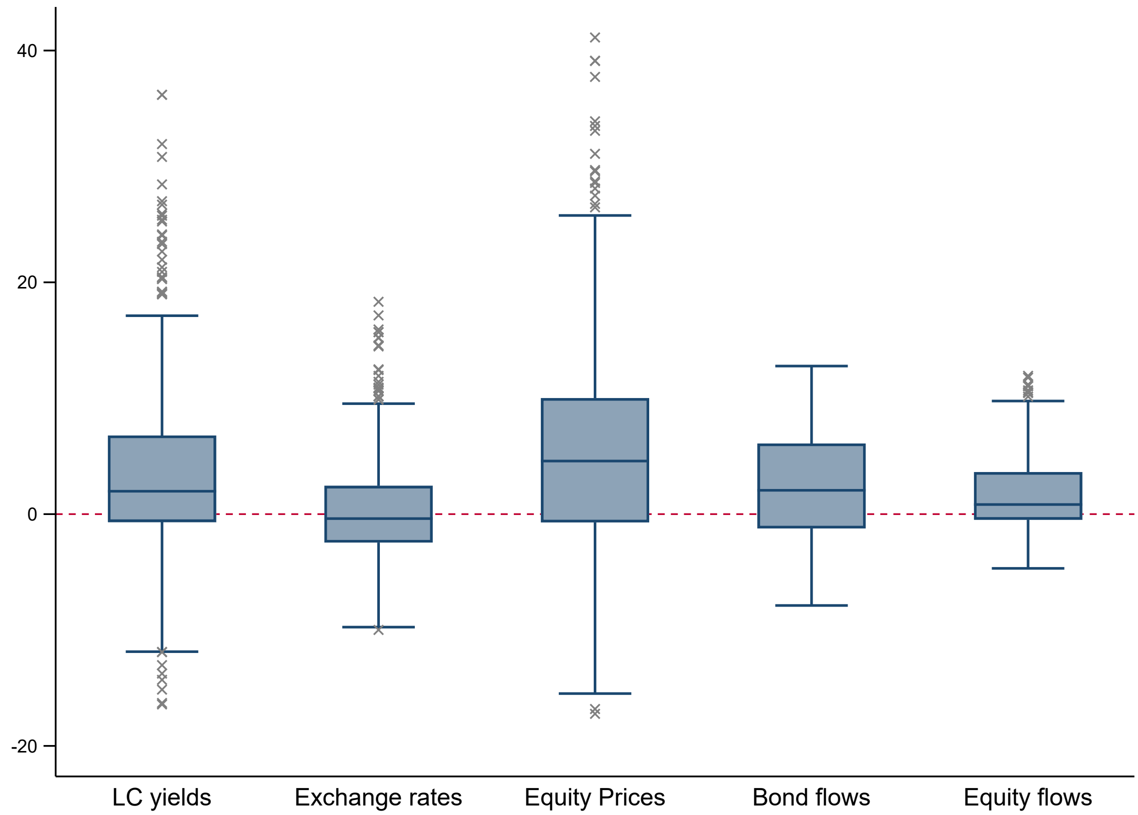
But this does not mean that no relationship exists at all. The graphs show that some yield spikes are associated with very negative outcomes in EMEs, the taper tantrum being a case in point. This begs the question of what are the drivers of such across-spikes variation? We tackle this question in the next subsection.

3.2 Baseline regressions

Table 3 shows the results of the various DS LASSO regressions for our outcome variables of interest. Next to the estimated coefficients we report, in parenthesis, their standard errors. Statistical significance is indicated by stars, with superscripts "$**$" and "$***$" denoting significance at 5 and 1 percent levels, respectively. We will first go through the results outcome variable-by-outcome variable, before discussing patterns that cut across outcomes.

We find that changes in LC bond yields and EM exchange rates are related to a surprisingly small number of key variables, above all the US term premium. Increases in LC bond yields are positively related to the size of the increase in US yields and changes in the US term premium and commodity prices. They are particularly large if the US term premium was compressed at the outset of the yield spike. All other variables are statistically insignificant.

Figure 2: What happened to EMEs during the baseline sample of US yield spikes?

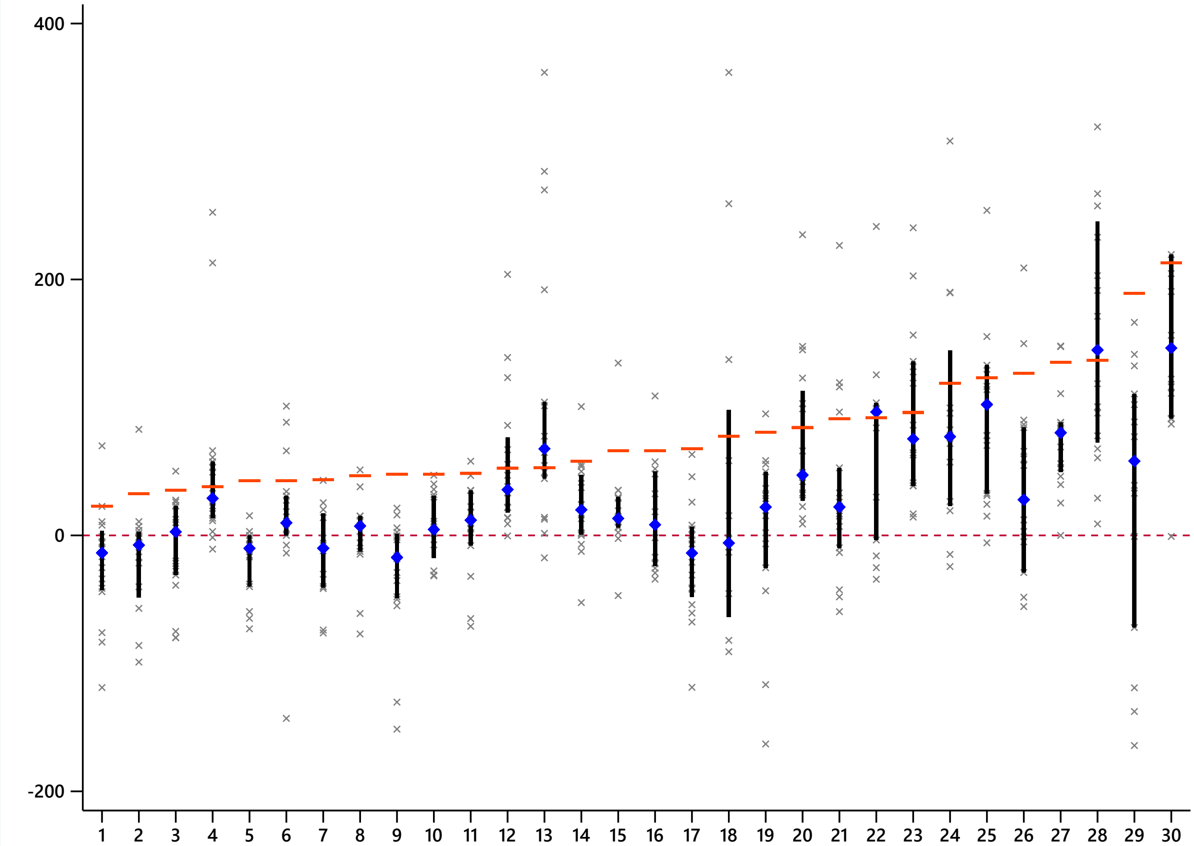


This figure shows box plots of start to peak changes in the EME outcomes of interest: local currency yields of 10-year sovereign bonds (in basis points scaled by 10), nominal exchange rates and equity prices (in percentage points), and portfolio bond and equity fund flows (as percentage of total net assets at the beginning of the spike). The box plots show the distribution of the these outcomes in the sample of 17 EMEs: Argentina, Brazil, Chile, China, Colombia, India, Indonesia, Korea, Mexico, Malaysia, Peru, Philippines, Poland, Russian Federation, Thailand, Turkey and South Africa. Each variable is winsorized at 2% and 98% to reduce the optical effect of outliers. The thick line inside the box shows the median of the variable across EMEs and the shaded box denotes the inter-quantile range. Outliers are indicated by $\times$ and are located above and below adjacent values. In turn, adjacent values are defined as values $\pm 3/2$ times the inter-quantile range (changes in local currency yields are scaled by 10, so that they can be plotted in the same vertical axis as the other variables).

The US term premium is also an important driver of EM exchange rates during our yield spike episodes, alongside the exchange rate of the US dollar against a broad basket of currencies.[16] Other variables that turn out to be statistically significant are revisions in the consensus forecast for EM domestic inflation and changes in EM short-term interest rates, the latter presumably reflecting the central bank's reaction to the depreciation.

[16]While an appreciation of the US dollar would be expected to show up mechanically as depreciation of the currencies in our sample of countries, this does not suffice to explain our result. The US dollar broad index of the Board of Governors of the Federal Reserve System is made up of 26 currencies, and our sample of countries represent only 42 percent of the index (average in 2006-2022).

Figure 3: Changes in local currency yields in EMEs during US yield spikes



This figure shows scatter plots of start to peak changes in local currency yields of 10-year sovereign bonds (in basis points) in our sample of 17 EMEs during the baseline 30 yield spikes. The data is sorted increasingly from left to right in the horizontal axis by the size of the change in US yields during the spike. The horizontal dark orange marker indicates the change in US 10-year yields during the spike (also in basis points). The blue diamond shows the median change in LC yields across the 17 EMEs, and the thick black bar shows the inter-quantile range. Other values are indicated by ×. In order to reduce the optical effect of outliers, the plot omits values below (above) the 2 (98) percentile.

By contrast, we find many more drivers for EM equity prices and fund flows during US yield spikes. Equity prices are related to the same factors as exchange rates, in addition to the size and speed of the yield spike, S2P changes in the VIX, US corporate bond spreads and 5 year breakeven inflation. Of the EM fundamentals, downward revisions in domestic growth also weigh on equity prices.

Fund flows are also related to a larger number of variables. Bond flows are positively correlated with changes in the VIX and US equity prices. They are negatively correlated with changes in the broad dollar index, its level at the outset of the episode, and changes in the US term premium, corporate bond spreads and break-even inflation rates. Yield spikes driven by increases in US breakeven inflation also tend to see smaller flows. Among the EM factors, flows tend to be larger if cumulative inflows in the previous 12 months were also large and if the exchange rate appreciated as well as in times of increasing domestic growth forecasts. By contrast, they tend to be smaller (or negative) if the domestic central bank raises interest rates or if international reserves are low. Flows into equity funds tend to be larger if the yield spike was driven by an increase in US breakeven rates, when the VIX goes up, the US term premium is low at the outset of the spike, and if US breakeven inflation and inflation forecasts go up. By contrast, they tend to be smaller if US yields rise very rapidly, if the VIX and the US dollar were high at the outset of the episode, if the US term premium and corporate spreads increase, if there is bad macroeconomic news and if the outlook for US growth is revised downwards. The only EM variable that turns out to be significant is EM bond (but not equity) inflows in the previous 12 months.

There are some patterns that cut across the different outcome variables.

First of all, the size and speed of US yield increases plays a surprisingly small role. As expected, larger increases in US yields are positively correlated with increases in EM LC yields once one controls for other factors. The positive relationship with EM equity prices is harder to explain. We hypothesise, following Hoek *et al.* (2022), that this probably reflects the reason behind the increase in US yields that are not perfectly controlled for by the remaining variables. Alternatively, it could be that the VIX does not properly reflect the risk appetite of equity investors, as suggested by Barras and Malkhozov (2016).

Second, the only variable that is significant for all outcome variables is the S2P change in the US term premium. Yield spikes driven by the decompression of the US term premium tend to feature larger increases in EM LC yields, exchange rate depreciation and larger declines in EM equity prices and flows to bond funds.[17] Curiously, flows into EM equity funds tend to be larger in such episodes, something we do not have a good explanation for. EM LC bond yields also increase by more if the term premium was comparatively low at the outset of the episode, although this does not appear to play a role in explaining exchange rates, equity prices and bond flows. Only flows into EM equity flows tend to be associated with the starting value for the US term premium, for whatever reason.

It is not clear what drives the prominent role of the US term premium. It could be related to

[17]This is consistent with the evidence in Albagli *et al.* (2019), who find that increase in US interest rates associated with a rise in the term premium result in much larger spillovers to EMEs than increases associated with changes in the expected path for policy rates. Mehrotra *et al.* (2019) also find significant effects of changes in the real component of the term premium and somewhat smaller ones for the nominal component. That said, the coefficient on the expected real interest rate component is slightly larger.

unconventional monetary policy, which played an important role during most of our sample and tends to affect long term yields by compressing the term premium (Curcuru *et al.*, 2018). Increases in US term premia may also have spillovers to EMEs by increasing risk perceptions of global investors, as in the narrative of Kalemli-Ozcan (2019), or by increasing term premia in EMEs, as documented by Albagli *et al.* (2019) around FOMC announcement days. That said, the precise mechanisms are not clear.

Third, another key variable is the US dollar exchange rate, which comes out significant in all equations except the one for EM LC yields [18]. Yield spikes with dollar appreciation are associated with larger EM depreciation and declines in equity prices and bond (but not equity) flows when they go hand in hand with an appreciation of the US dollar. As noted before, this goes beyond the mechanical effect of currencies being included in the broad dollar index, both because of the size of the dollar decline and the fact that the vast majority of countries in our sample are relatively minor trading partners of the United States and thus have small or zero weights in the index. Instead, we believe that our result provide support for the existence of a risk-taking channel of the exchange rate and an important role for the value of the US dollar, as argued by Bruno and Shin (2014, 2015), Avdjiev *et al.* (2019) and Obstfeld and Zhou (2022).

Yield spikes associated with increases in US inflation expectations – as indicated by rising breakeven inflation rates, a positive reading of the indicator for the yield spike being mainly driven by breakeven inflation, or upward revisions in consensus inflation forecasts – are associated with larger EM depreciations and equity price declines, but increases in fund flows. There is no relationship with EM LC yields. The relationship between EM outcomes and US growth is weaker: negative US macroeconomic surprises have no explanatory power for the three price variables, although they tend to increase capital flows to EMEs. Upward revisions in the consensus forecast for US growth in the coming 12 months are positively correlated with flows into bond funds but not with any other outcome variable. The more prominent role of inflation versus growth is in line with Hoek *et al.* (2022), Ciminelli *et al.* (2022), and Arteta *et al.* (2022), who find that inflation shocks tend to have larger adverse spillovers to EMEs than growth shocks.

A somewhat puzzling result is the positive relationships between S2P increases in the VIX and EM equity prices and fund flows. While at face value this sounds counter-intuitive and is at odds

[18] The lack of significance of the broad US dollar is in line with the findings of, Hofmann, Shim and SHIN (2020), who find a close relationship between the risk premium component in these yields and the *bilateral* US dollar exchange rate. By contrast, the broad US dollar index is not signficant once it has been orthogonalised with respect to the bilateral exchange rate.

with the influential paper by Rey (2015), other recent papers have suggested that the VIX is not a particularly good measure for capturing the risk appetite of investors. For instance, Barras and Malkhozov (2016) argue that changes in the VIX may to be driven by the balance sheet capacity of banks, who may behave differently than the investors who tend to purchase EM-dedicated mutual funds. Similarly, Avdjiev *et al.* (2019) argue that the US broad dollar exchange rate is a much better proxy for global risk perceptions than the VIX, which loses significance once on also controls for movements in the dollar exchange rate.

Somewhat surprisingly, EM fundamentals seem to matter little. Revisions in the consensus forecasts for growth and inflation only enter some of the regression significantly, ratings or rating changes and the current account do not appear to matter at all, the level of international reserves only for bond flows. The positive coefficients on cumulative bond flows and currency appreciation in the fund flow regressions could indicate that investors in EMEs follow quite persistent portfolio reallocation strategies, perhaps because of momentum trading or because of smoothing portfolio reallocation in illiquid markets.

Bad outcomes in EMEs tend to be associated with increases in domestic policy rates. We believe that this is likely to reflect reverse causality: EME central banks increase interest rates in response to adverse outcomes. That said, at the moment we do not have the means to test for this.

Only higher levels of domestic inflation came out as robustly associated with worse EME outcomes, and only for currency depreciation.

Importantly, the estimated effects of these variables are economically significant. A 100 basis points (bps) increase in the US term premium is correlated with an increase in LC yields of about 115 bps, a 6 percent EM currency depreciation, a fall in domestic equity prices of about 5 percent, and bond and equity outflows of up to 8 percent of net total assets at the onset of the spike. Similarly, a 10 percent appreciation of the US broad dollar index is associated with a currency depreciation in EMEs of about 8 percent and a similarly-sized fall in equity prices. A 100 basis points increase in high-yield corporate spreads during a yield spike is correlated with a fall of about 5 percent in equity prices across EMEs. A 1 percent increase in US inflation expectations, as captured by BEIRs, is correlated with a EME depreciation of about 6 percent and a fall of about 12 percent in equity prices.[19]

[19] For reference, the average change in these variables across the sample of US yield spikes is as follows: 51 bps for the US term premium, a flat US dollar broad index (-0.1 percent change), a fall in high-yield corporate spreads of 115 bps, and an increase in break-even inflation expectations of 37 bps.

Table 3: Baseline results for country-level outcomes. 10Y spikes 2004-2022

This table reports baseline results of estimating model 1 based on the Double Step LASSO estimator of Belloni *et al.* (2012), Belloni *et al.* (2014) and Belloni *et al.* (2016) as explained in section 2.3. Each dependent variable enters the covariate selection model one at a time. Standard errors are shown in parenthesis, next to estimated coefficients. ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

	(1)	(2)	(3)	(4)	(5)
	LC yields	Exchange rates	Equity prices	Bonds	Equity
Dummy=1 BEIR-driven spike	14.048 (9.614)	1.136 (0.792)	-2.198 (1.712)	-2.326*** (0.871)	1.424*** (0.372)
Size of spike	6.203** (2.896)	-0.501 (0.285)	0.881** (0.424)	0.303 (0.156)	0.130 (0.098)
Speed of spike	-4.169 (2.326)	-0.032 (0.120)	-0.844*** (0.232)	0.001 (0.189)	-0.517*** (0.078)
VIX S2P change	-0.919 (1.631)	-0.071 (0.058)	0.206*** (0.058)	0.415*** (0.045)	0.259*** (0.022)
VIX at start (risk-off)	-0.791 (1.896)	-0.202 (0.109)	0.153 (0.260)	0.015 (0.139)	-0.336*** (0.065)
USD Broad index S2P change	-0.245 (4.603)	0.797*** (0.134)	-0.785*** (0.264)	-0.114** (0.053)	0.149*** (0.039)
USD Broad index at start	-3.056 (1.570)	0.000 (0.059)	-0.088 (0.087)	-0.184*** (0.050)	-0.052** (0.020)
US 10Y term premium S2P change	1.151*** (0.323)	0.063*** (0.014)	-0.052** (0.026)	-0.087*** (0.009)	-0.025*** (0.007)
US 10Y term premium at start	-0.750*** (0.228)	0.005 (0.009)	0.009 (0.021)	0.013 (0.016)	0.038*** (0.006)
US HY corporate spread S2P change	0.089 (0.059)	0.010 (0.006)	-0.037*** (0.011)	0.003 (0.004)	-0.009*** (0.003))
Commodity prices S2P change	0.028** (0.013)	-0.001 (0.001)	0.001 (0.002)	-0.002*** (0.000)	-0.001 (0.000)
US Breakeven 5Y S2P change	0.030 (0.468)	0.059** (0.029)	-0.119*** (0.023)	0.125*** (0.012)	0.092*** (0.011)
SP 500 S2P change	-2.041 (2.417)	-0.103 (0.100)	0.317*** (0.092)	0.235*** (0.075)	0.005 (0.051)
US Citi's macro surprises S2P	0.115 (0.245)	-0.029 (0.017)	0.019 (0.027)	-0.036*** (0.013)	-0.015*** (0.005)
US GDP growth forecast	13.982 (10.000)	-0.558 (0.437)	1.114 (0.824)	0.067 (0.719)	-1.567*** (0.205)
US inflation forecast	20.089 (19.328)	1.159 (0.816)	-1.315 (1.610)	0.192 (0.970)	1.152** (0.582)
US change GDP growth forecast	0.291 (0.235)	0.018 (0.009)	-0.029 (0.021)	0.033*** (0.002)	-0.002 (0.004)
US change inflation forecast	0.110 (0.131)	0.009 (0.009)	-0.031 (0.018)	0.023*** (0.007)	0.028*** (0.004)
EMEs policy rate S2P change	0.059 (0.050)	0.005*** (0.001)	-0.007*** (0.001)	-0.002** (0.001)	-0.001 (0.001)
EMEs appreciation before	0.307 (1.120)	0.041 (0.034)	-0.073 (0.072)	0.049** (0.024)	0.002 (0.016)
EMEs Bond flows before	-0.481 (0.410)	0.028 (0.019)	0.084 (0.101)	0.088*** (0.016)	0.032*** (0.011)
EMEs Equity flows before	0.249 (0.918)	0.036 (0.037)	-0.190 (0.113)	-0.017 (0.051)	-0.003 (0.030)
EMEs change S&P rating LC	-19.233 (29.517)	-0.289 (0.278)	0.684 (1.209)	-0.342 (0.536)	-0.323 (0.345)
EMEs GDP growth forecast	9.316 (5.310)	-0.028 (0.495)	-1.497** (0.691)	0.523** (0.249)	-0.005 (0.089)
EMEs Inflation forecast	13.680 (10.207)	0.287*** (0.025)	0.480*** (0.095)	-0.036 (0.051)	-0.000 (0.040)
EMEs S&P rating LC	-7.113 (10.340)	-0.031 (0.207)	-0.192 (0.524)	-0.039 (0.146)	-0.167 (0.123)
EMEs Reserves to GDP	2.260 (1.903)	-0.011 (0.030)	0.091 (0.134)	-0.098** (0.046)	-0.056 (0.034)
EMEs Current account balance	3.372 (2.682)	-0.005 (0.113)	0.367 (0.288)	0.025 (0.107)	0.062 (0.065)
Obs	458	510	499	510	510

3.3 Co-exceedances

The analysis above gives us an idea of what drives the behaviour of individual EM variables during US yield spikes. We complement this by aggregating the various outcome variables into one metric, namely the number of variables with realisations located in the (adverse) tail of the distribution during each yield spike. Borrowing terminology from the extreme value theory, we call this "co-exceedances". Having calculated this metric, we then estimate which variables explain a larger number of concurrent adverse outcomes.

Before measuring co-exceedances we need to define exceedances. For LC yields, exchange rates, and equity prices, an exceedance takes place when the S2P change during an episode falls into the top quartile of the respective variable's distribution across in the sample of 30 yield spikes. For portfolio fund flows (the sum of bond and equity),[20] an exceedance takes place when cumulative outflows at the end of the US yield spike are larger than 1 percent of net total assets at the start of the spike. Co-exceedances then are simply the number of exceedances during any one episode. This means that the maximum number of co-exeedances per country is four and, for our full sample of 17 countries, 68. Figure 4 shows the number of exceedances and co-exceedances during the 30 US yields spikes. To increase readability, we mark yield spikes with a larger number of exceedances and co-exceedances in a darker colour.

Not surprisingly, the largest number of co-exceedances in the sample were observed during the 2013 taper tantrum (54), closely followed by the lift-off of US interest rates after the pandemic (December 2021 to June 2022, 47), the 2004 Fed tightening (42) and the aftermath of the taper tantrum in late 2013/early 2014 (41). Perhaps surprisingly, the sharp rise in US yields during the market turbulence during the initial phase of the Covid-19 pandemic showed a considerably lower number of co-exceedances (27). 12 out of the 30 episodes, though, had a number of co-exceedance in the single digits.

What drives the number of co-exceedances in a country and episode? The results of our mulit-nomial logit regression are striking: the factors that explain each individual outcome of interest separately also explain the joint occurrence of adverse outcomes. These are the change in the US term premium, US dollar appreciation, HY corporate spreads and EME inflation expectations. Again, the coefficient on the VIX is puzzling: co-exceedances are less likely if the VIX is high at the

[20]To avoid putting undue emphasis on fund flows, we combine bond and equity flows into a single variable.

Figure 4: Number of exceedances and total co-exceedances in EMEs during US yield spikes

		Exceedances					
Start	Peak	LC yields	Exchange rates	Equity prices	Portfolio funds	Co-Exceedances	Yield spike
16.Mar.04	14.Jun.04	7	7	13	15	42	**Tightening 2004**
25.Oct.04	02.Dec.04	0	0	2	0	2	**Tightening 2004**
09.Feb.05	22.Mar.05	1	1	6	0	8	
01.Jun.05	06.Nov.05	3	5	1	0	9	
17.Jan.06	28.Jun.06	8	6	6	1	21	**Tightening 2006**
04.Dec.06	29.Jan.07	0	2	2	0	4	
07.Mar.07	12.Jun.07	1	0	0	3	4	**Tightening 2007**
17.Mar.08	16.Jun.08	7	5	6	2	20	**Bear Stearns**
30.Dec.08	10.Jun.09	7	3	1	1	12	**Lehman Brothers aftermath**
01.Oct.09	28.Dec.09	1	1	0	0	2	
08.Feb.10	05.Apr.10	0	0	0	0	0	
07.Oct.10	08.Feb.11	9	4	6	0	19	
22.Sep.11	27.Oct.11	0	0	1	13	14	
31.Jan.12	19.Mar.12	1	1	1	0	3	
24.Jul.12	16.Sep.12	0	0	3	0	3	
18.Nov.12	11.Mar.13	0	2	0	0	2	
02.May.13	05.Sep.13	12	15	10	17	54	**Taper tantrum**
23.Oct.13	01.Jan.14	4	11	11	15	41	**Taper tantrum aftermath**
03.Feb.14	02.Apr.14	0	0	2	15	17	
01.Feb.15	10.Jun.15	6	11	8	4	29	
11.Feb.16	13.Mar.16	1	1	0	0	2	**Tightening 2016**
10.Jul.16	13.Mar.17	5	6	2	0	13	
07.Sep.17	21.Feb.18	4	5	2	0	11	
02.Apr.18	17.May.18	2	11	8	0	21	
26.Aug.18	08.Nov.18	2	4	11	4	21	
03.Sep.19	11.Nov.19	1	1	2	0	4	
09.Mar.20	07.Jun.20	0	5	5	17	27	**Covid-19 pandemic**
04.Aug.20	31.Mar.21	11	5	1	0	17	
03.Aug.21	21.Oct.21	7	6	4	2	19	**Inflation scare post-Covid**
05.Dec.21	14.Jun.22	15	10	11	11	47	**Lift-off after pandemic**

beginning of the episode or goes up during it.

The ordered logit approach also allows us to extract the implied probabilities of moving from k to $k+1$ co-exceedances as we change each of the covariates. As Figure 5 shows, this relationship can be highly non-linear. This is particularly the case for the US term premium and the broad dollar exchange rate. For example, holding the other variables constant at their sample mean, the probability of there being co-exceedances increases from less than 40 percent at low values of the change in the US term premium to over 90 percent at very high levels (upper left plot). Similarly,

Table 4: Multinomial ordered logit model. 10Y spikes 2004-2022

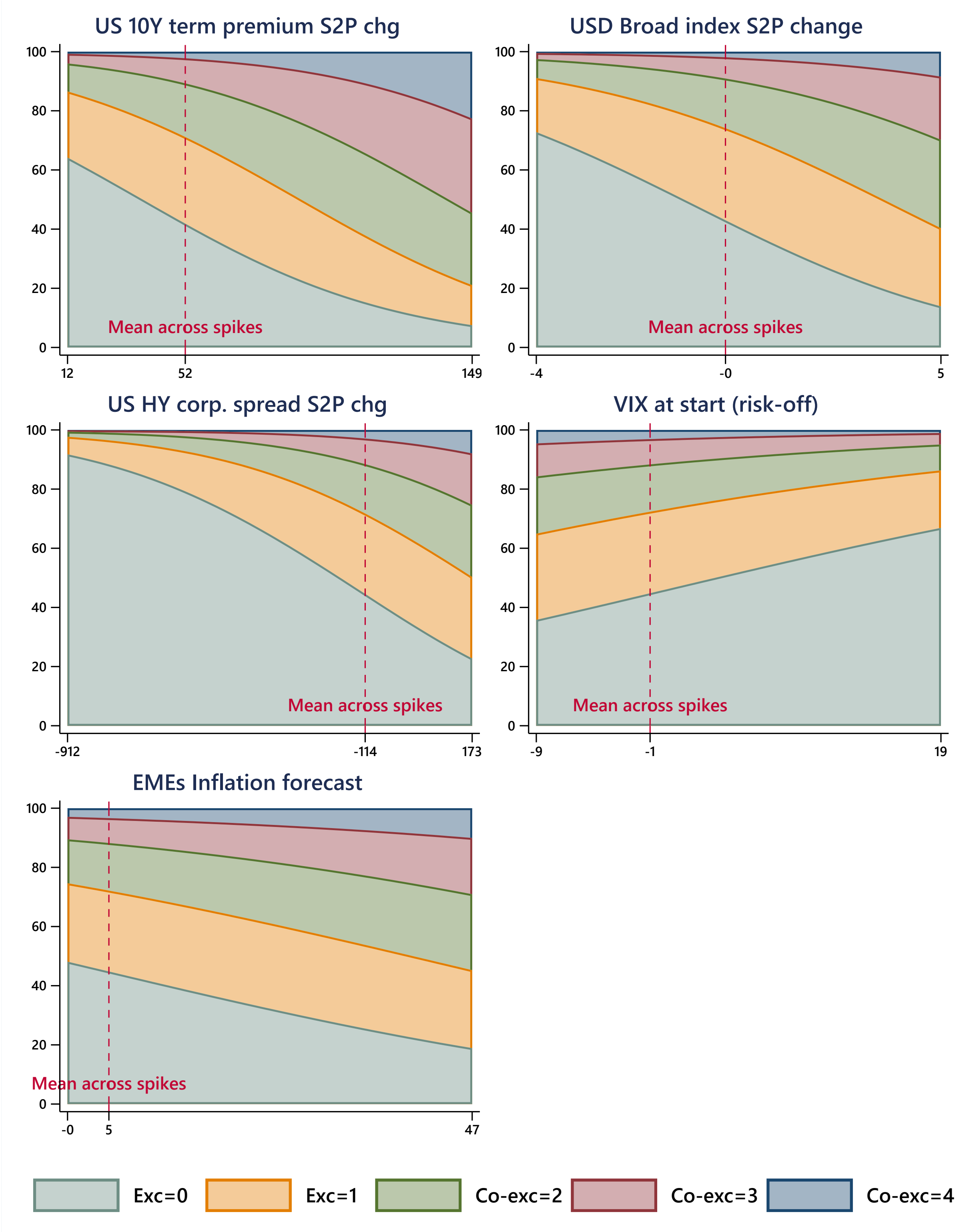
This table reports baseline results of estimating the multinomial Logit model of equation 2. To reduce clutter, the table only shows the estimated coefficients. Their statistical significance is indicated by stars, with superscripts "∗∗" and "∗ ∗ ∗" denoting significance at 5 and 1 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Covariates one-by-one	All covariates	Global & US covariates	EME covariates	Key covariates	Final set covariates
Dummy=1 BEIR-driven spike	-0.913***	0.738***	0.693**		-0.118	
Size of spike	0.241***	-0.159	-0.104			
Speed of spike	0.016	-0.174***	-0.156***		0.029	
VIX index S2P change	0.007	-0.112***	-0.114***		-0.080***	-0.076***
VIX index at start (risk-off)	-0.050***	-0.235***	-0.205***		-0.068**	-0.061***
USD Broad index S2P change	0.421***	0.330***	0.341***		0.358***	0.357***
USD Broad index at start	-0.006	-0.027	-0.024			
US 10Y term premium S2P change	0.012***	0.048***	0.042***		0.031***	0.030***
US 10Y term premium at start	-0.003***	0.015***	0.012**		0.003	
US HY corporate spread S2P change	0.003***	0.008**	0.006**		0.004***	0.005***
Commodity prices S2P change	0.001***	0.001	0.001			
US Breakeven 5Y S2P change	-0.007***	0.016	0.013			
SP 500 S2P change	-0.075***	-0.079	-0.113***			
US Citi's macro surprises S2P	-0.001	-0.007	-0.006			
US GDP growth forecast	0.225***	-0.401**	-0.342**		0.071	
US inflation forecast	0.299**	0.269	0.065			
US change GDP growth forecast	-0.001	0.001	0.003			
US change inflation forecast	0.002	0.003	0.004			
EMEs policy rate S2P change	0.001	0.000		0.001		
EMEs appreciation before	-0.010	0.010		-0.009		
EMEs Bond flows before	0.004	-0.041**		-0.008		
EMEs Equity flows before	0.035***	0.040		0.046***		
EMEs change S&P rating LC	0.042	0.251		0.038		
EMEs GDP growth forecast	-0.012	-0.039		-0.010		
EMEs Inflation forecast	0.037***	0.033**		0.032***	0.037***	0.037***
EMEs S&P rating LC	-0.060	-0.044		-0.000		
EMEs Reserves to GDP	-0.008	0.003		0.015		
EMEs Current account balance	-0.047***	-0.031		-0.060***		
Obs		458	458	458	458	458

for the US dollar index, this probability increases from under 30 percent to well over 80 percent. Conversely, the probability of really bad outcomes (4 co-exceedances) increases from almost zero for small changes in the US term premium or small changes in the US dollar exchange rate to over 20 percent and just short of 10 percent, respectively. The relationship with US high yields spreads are similar in both nature and magnitude as those for the US term premium, whereas those for the VIX at the start of the yield spike episode and changes in EME inflation forecasts tend to be less steep and closer to linear.[21]

[21] While one needs to be cautious in generalizing these results, because the estimation is based on a subset of an already small number of extreme bad outcomes, they give us an idea of the factors at play during a yield spike.

Figure 5: Implied probabilities of exceedances and co-exceedances



4 Robustness checks

4.1 Analysis based on EME averages: a true cross-section exercise

The results from the analysis in Section 3 are based on country-level outcomes for 17 EMEs. While the use of the cross-section of EMEs variation may help to identify the effects of yield-specific covariates common across countries, there may be the concern that there is not sufficient variation in the data to correctly identify those effects. So, in this robustness check we estimate both models in equations 1 and 2 for the average outcomes across EMES, ie the cross section of episodes only.

Table A.2 in the Appendix presents the results. The first five columns show DS LASSO regressions for each of the outcome variables of interest. Each of these regressions are run over the baseline 30 yield spikes. The last four columns of the table show the results for co-exceedances. Column 6 presents results for univariate regressions, column 7 for all covariates at once (where unsurprisingly none of the covariates turns out to be significant), column 8 runs the regression with the covariates that were significant in column 6, and column 9 shows the result of running the model with the covariates that were significant in the country-level analysis. Figure A.3 in the Appendix shows the non-linearity of the effects estimated in column 8. The baseline results hold: US term premium and US dollar appreciation are the key drivers of the likelihood of negative outcomes in EMEs.

4.2 Dropping influential yield spikes: Lehman Brothers aftermath and 2013 taper tantrum

Another concern could be that our results are entirely driven by two episodes with very large increases in the US term premium and the value of the dollar. The spikes following the Lehman Brothers bankruptcy (30.Dec.08) and the 2013 taper tantrum (02.May.13) are clearly outliers in the increase in the US term premium (Figure A.4 in the Appendix). They also followed circumstances that may (hopefully) be unique. That said, our results remain largely unchanged if we drop these two events from the sample (Appendix Table A.3). The key variables driving negative outcomes in EMEs are the same as before, and the estimated magnitude of their effects is in the same ballpark as the ones estimated with the full sample of spikes. In fact, the estimated effects of the increase in US term premium on EM LC yields and currency depreciation actually get *larger*.

4.3 Alternative episode identification in BBHP algorithm

Extending the 30-day minimum distance to 45 days but keeping the same censoring rule for the minimum yield increase as before reduces the number of yield spike episodes to 23 (Appendix Figure A.5 and Table A.4). While cycles on average last longer and US yields go up by more, most cycles tend to be the same as under the baseline definition, with the alternative algorithm collapsing two short-lived spikes into one and getting rid of the shortest episodes (Figure A.5). The regression results also remain broadly unchanged: the key drivers of negative outcomes in EMEs during US yield spikes continue to be the increase in US term premium, the appreciation of the US dollar, the increase in US high-yield corporate spreads, and US and EME inflation expectations. For some EME outcome variables the statistical significance of these explanatory variables increase as well as their magnitude (Appendix Table A.5).

4.4 Alternative estimators

We complement the baseline approach, in which we used the DS LASSO estimator to make inference on the covariates of interest one by one, with an approach in which inference is done in the two different sets of covariates of interest. First, we run one DS LASSO regression to make inference on the set of 18 global and US covariates that are common across yield spikes ($\boldsymbol{X}_s$ in equation 1) and selecting over the 10 EME conditions and fundamentals ($\boldsymbol{Z}_{i,s}$). We then run a second DS LASSO regression to make inference on the set of $\boldsymbol{Z}_{i,s}$ covariates, selecting over $\boldsymbol{X}_s$ covariates.[22] Remarkably, the two different estimations of the model — treating each covariate as the explanatory variable of interest and selecting over the remaining 27 covariates (Table 3) or treating sets of $\boldsymbol{X}_s$ or $\boldsymbol{Z}_{i,s}$ alternatively as explanatory variables of interest and selecting over the other set (Table A.6 in the Appendix) — lead to estimated coefficients of similar magnitude and statistical significance for the key drivers of negative EME outcomes. The main exceptions are the statistical significance of the change in the US dollar on EME equity prices (which is lost) and the magnitude of the effect of the change in the US term premium on EME equity prices (which doubles in size).

[22] In this setting, a first LASSO regression is estimated for the EME outcome of interest $y_{i,s}$ and then LASSO regressions are estimated for each covariate of interest in either $\boldsymbol{X}_s$ or $\boldsymbol{Z}_{i,s}$. All regressions are conditional on the full sample of 28 covariates (and country fixed effects), but the set of covariates over which selection is made varies: for inference on global and US variables, selection is made over EME covariates, and vice-versa. The estimated coefficients and corresponding inference for each of $\boldsymbol{X}_s$ and $\boldsymbol{Z}_{i,s}$ are obtained in regressions of the EME outcome of interest $y_{i,s}$ on the union of the covariates picked at each step, plus the full set of covariates of interest ($\boldsymbol{X}_s$ or $\boldsymbol{Z}_{i,s}$). Note that this approach implies that in each regression the full set of variables of interest is included (either $\boldsymbol{X}_s$ or $\boldsymbol{Z}_{i,s}$), regardless of the information value of a given covariate at each step.

We also check the robustness of the baseline results to estimate the model using the alternative LASSO estimator proposed by Chernozhukov, Chetverikov, Demirer, Duflo, Hansen, Newey and Robins (2018). In this approach, covariate selection and inference are done by splitting the sample in subsamples and obtaining key regressors for the dependent variable and the covariate(s) of interest, and then partialing out the effects of those key regressors from both the dependent variable and the covariate of interest. This double orthogonalization (or cross-fit partialing out) procedure is dubbed "double machine learning" by Chernozhukov *et al.* (2018), who show that it has better finite-sample properties in high-dimensional models than other covariate selection techniques (including DS LASSO). We refer the reader to Chernozhukov *et al.* (2018) for a more detailed presentation of this estimator.[23]

Table A.7 in the Appendix shows the results after estimating model 1 employing the cross-fit partialing out estimator (treating each covariate as the explanatory variable of interest and selecting over the remaining 27 covariates). Reassuringly the main baseline findings on the explanatory variables of negative EME outcomes are obtained. The main differences are slightly smaller magnitudes of the estimated effects, particularly for US inflation expectations on equity prices, and the effect of the increase in US term premia on LC yields vanishes. Similar results are obtained if we implement the estimator treating sets of $\boldsymbol{X}_s$ or $\boldsymbol{Z}_{i,s}$ covariates alternatively as explanatory variables of interest and selecting over the other set.

5 Concluding remarks

Increases in yields in major advanced economies, above all the United States, can have widely differing effects on EMEs. Some increases are barely felt, while others make emerging markets tremble. In this paper we identify the factors that help explain those differences. This complements the recent work of Albagli *et al.* (2019), Hoek *et al.* (2022), Ciminelli *et al.* (2022), and Arteta *et al.* (2022), who ask a similar question for changes in US policy rates.

We identify two variables in particular that have significant statistical and economic explanatory power for adverse spillovers: (i) the US term premium and (ii) the broad US dollar exchange rate. While the importance of the US dollar has been widely explored in similar context and there is considerable evidence on the channels at work, there is much less work on the impact of the US term premium and the channels through which it affects EMEs. Exploring the mechanism through which increases in US term premium have negative spillovers to EMEs is left for future resarch.

[23]We implement this estimator employing the command `XPOREGRESS` available in Stata, release 17.

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Appendix with Additional Figures and Tables

- Figures
  - Baseline sample of yield spikes in 10-year
  - Scatters of changes in local currency yields in EMEs during US yield spikes
  - Robustness checks
    * Implied probabilities ordered model with averages across EMEs
    * Scatters with change in term premium and change in US dollar during yield spikes
    * Plot alternative definition of yield spikes
- Tables
  - Summary stats baseline sample of yield spikes of 10-year Treasury in Jan 2004 – Jun 2022
  - Robustness checks
    * Results for EME average outcomes
    * Results after dropping Lehman Brothers aftermath and taper tantrum spikes
    * Summary statistics of spikes under alternative dating algorithm
    * Results with alternative definition of yield spikes
    * Results with alternative way of implementing baseline DS LASSO covariate selection estimator
    * Results with alternative covariate selection estimator: cross-fit partialing out

Figure A.1: Baseline sample of yield spikes in 10-year Treasuries

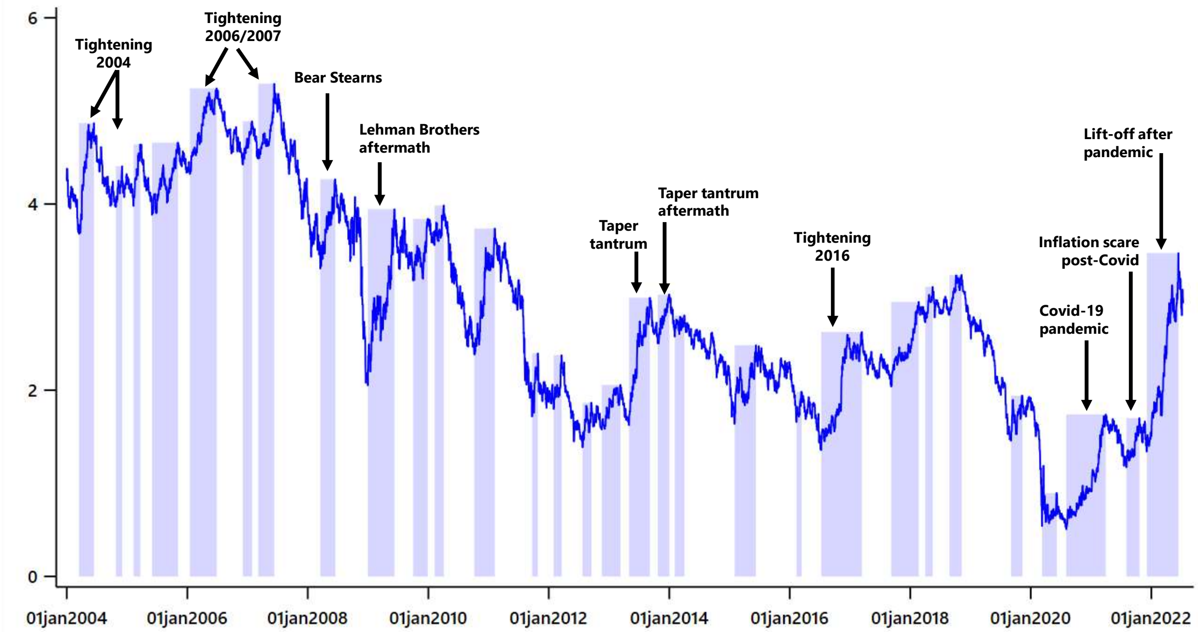
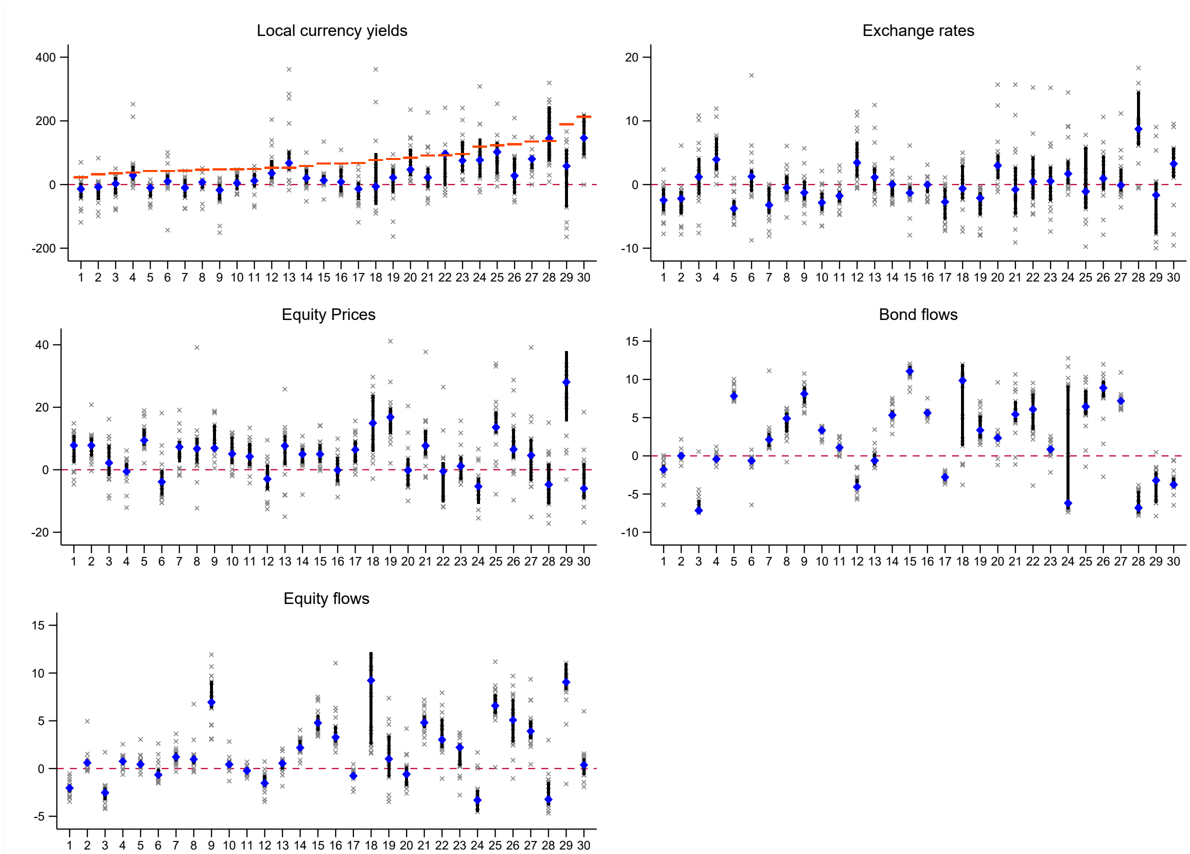


Figure A.2: Changes in local currency yields, exchange rates, equity prices and cumulative portfoio fund flows in EMEs during US yield spikes



This figure shows scatter plots of start to peak changes in local currency yields (in bps), nominal exchange rates (in percentage points), equity prices (in percentage points), and portfolio fund flows (split into bonds and equity) in the sample of 17 EMEs during the baseline 30 yield spikes. In each plot the data is sorted increasingly in the horizontal axis by the size of the change in US yields during the spike. The blue diamond shows the median change in the corresponding variable across the 17 EMEs, and the thick black bar shows the inter-quantile range. Other values are indicated by $\times$. In order to reduce the optical effect of outliers, the plots omit observations below (above) the 2 (98) percentile.

Figure A.3: Implied probabilities of exceedances and co-exceedances in the cross section

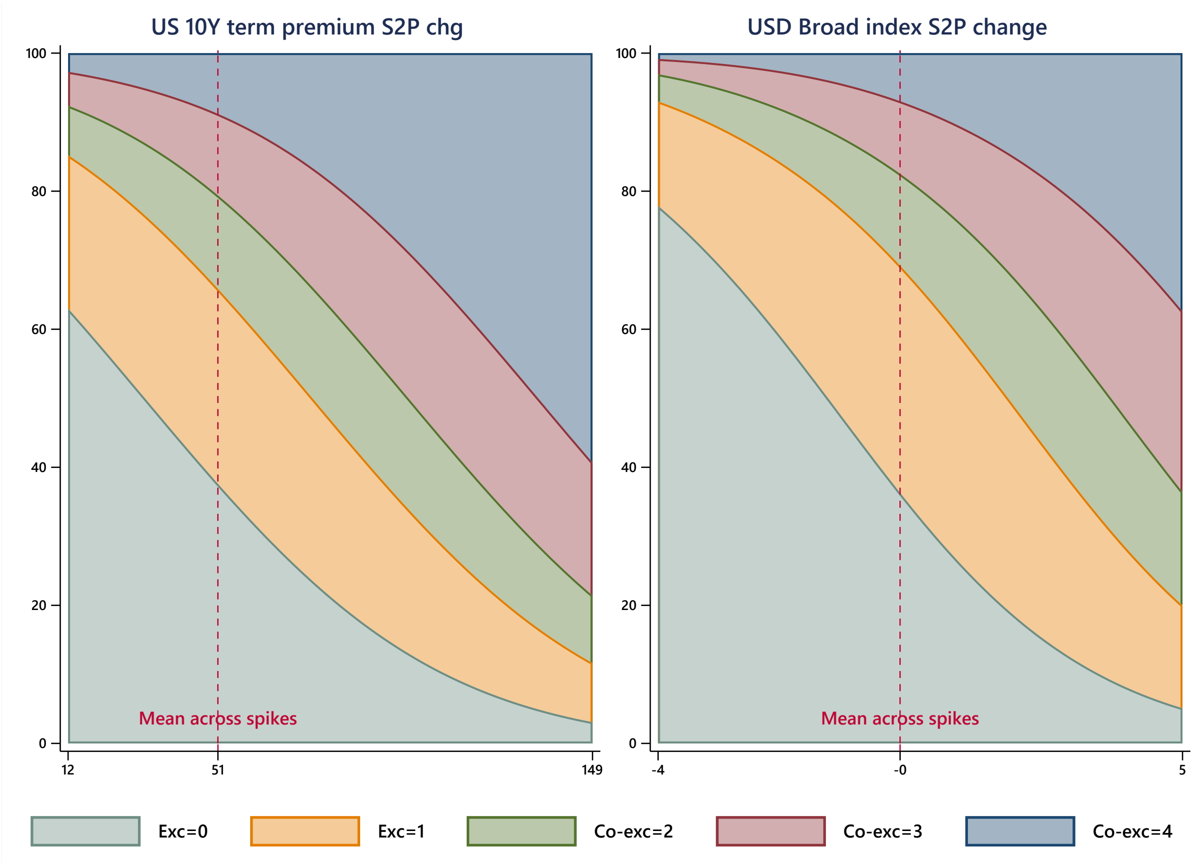


Figure A.4: Scatters with change in term premium and change in US dollar during yield spikes

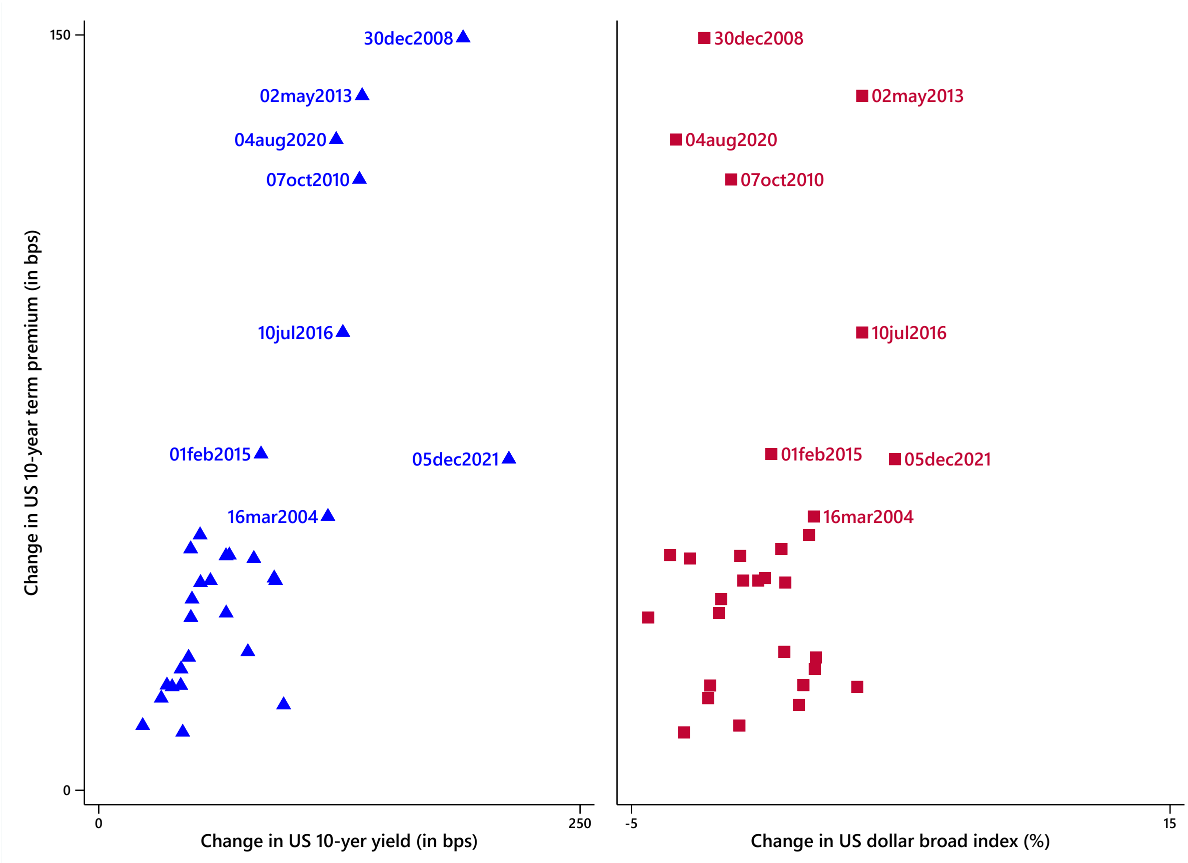


Figure A.5: Alternative definition of yield spikes

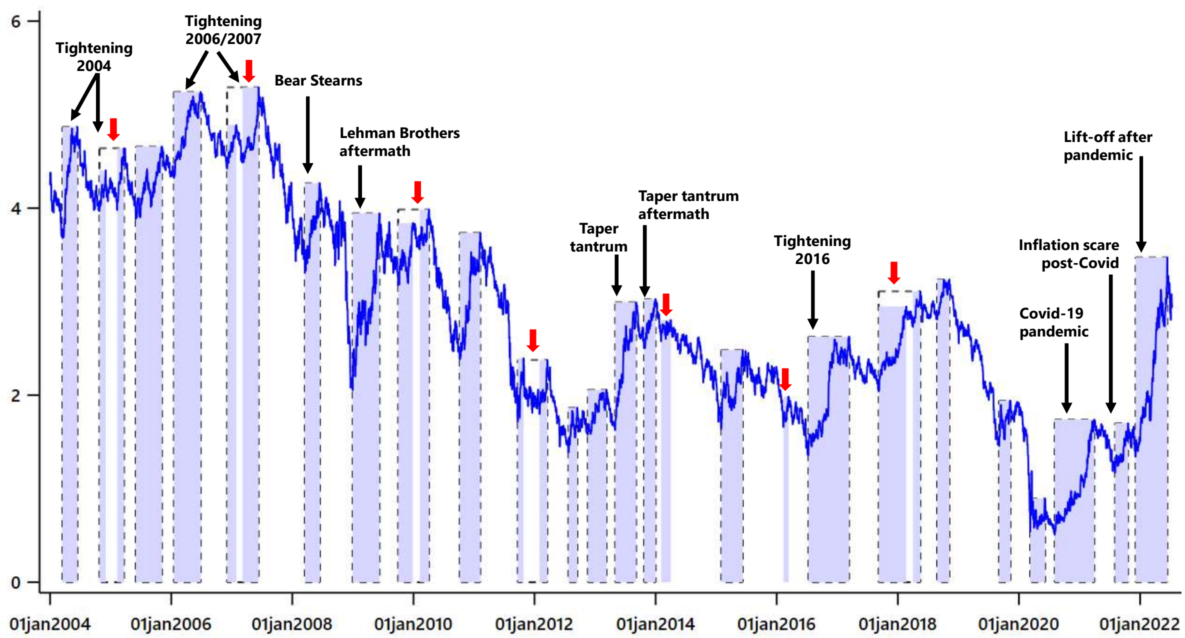


Table A.1: Baseline sample of yield spikes of 10-year Treasuries in Jan 2004 – Jun 2022

Start	End	Yield change in basis points	Yield change ratio to sd of 30-day changes	Speed bps per week	Days
16.Mar.04	14.Jun.04	119	5.1	9	90
25.Oct.04	02.Dec.04	44	1.8	8	38
09.Feb.05	22.Mar.05	66	2.8	11	41
01.Jun.05	06.Nov.05	77	3.4	3	158
17.Jan.06	28.Jun.06	92	4.1	4	162
04.Dec.06	29.Jan.07	47	2.1	6	56
07.Mar.07	12.Jun.07	81	3.8	6	97
17.Mar.08	16.Jun.08	96	4.6	7	91
30.Dec.08	10.Jun.09	189	8.9	8	162
01.Oct.09	28.Dec.09	66	2.8	5	88
08.Feb.10	05.Apr.10	43	1.8	5	56
07.Oct.10	08.Feb.11	135	5.7	8	124
22.Sep.11	27.Oct.11	68	2.6	14	35
31.Jan.12	19.Mar.12	58	2.2	8	48
24.Jul.12	16.Sep.12	48	1.9	6	54
18.Nov.12	11.Mar.13	48	1.9	3	113
02.May.13	05.Sep.13	137	5.5	8	126
23.Oct.13	01.Jan.14	53	2.1	5	70
03.Feb.14	02.Apr.14	23	1.1	3	58
01.Feb.15	10.Jun.15	84	4.5	5	129
11.Feb.16	13.Mar.16	32	1.9	7	31
10.Jul.16	13.Mar.17	127	7.4	4	246
07.Sep.17	21.Feb.18	91	5.9	4	167
02.Apr.18	17.May.18	38	2.4	6	45
26.Aug.18	08.Nov.18	43	3.0	4	74
03.Sep.19	11.Nov.19	48	3.2	5	69
09.Mar.20	07.Jun.20	35	2.3	3	90
04.Aug.20	31.Mar.21	123	7.4	4	239
03.Aug.21	21.Oct.21	53	3.1	5	79
05.Dec.21	14.Jun.22	213	12.7	8	191

Table A.2: Results for EME average outcomes. 10Y spikes 2004-2022

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	EME outcomes					Co-exceedances			
	LC yields	Exchange rates	Equity prices	Bonds	Equity	One by one	All US & global	Key covariates	Final cty reg
Dummy=1 BEIR-driven spike	27.219 (22.052)	0.490 (0.983)	-0.533 (2.078)	-2.302 (1.831)	-0.342 (1.009)	-1.112	-7.727	0.002	
Size of spike	18.323*** (2.830)	0.286 (0.151)	-0.020 (0.532)	-0.132 (0.355)	0.051 (0.197)	0.364***	-5.196	-0.310	
Speed of spike	-1.809 (3.064)	-0.123 (0.176)	-0.721** (0.355)	-0.110 (0.372)	-0.320 (0.223)	0.094	6.732		
VIX index S2P change	1.709 (1.249)	0.106 (0.084)	0.114 (0.116)	0.160 (0.109)	0.179*** (0.038)	0.009	-7.015		-0.087
VIX index at start (risk-off)	-0.005 (1.353)	-0.051 (0.080)	-0.001 (0.177)	-0.077 (0.161)	-0.053 (0.107)	-0.041	-0.472		-0.088
USD Broad index S2P change	5.240 (5.138)	0.991*** (0.199)	-0.968** (0.390)	-0.607 (0.377)	-0.013 (0.177)	0.470***	2.802	0.581**	0.535***
USD Broad index at start	-1.384 (1.557)	0.059 (0.082)	0.009 (0.177)	-0.092 (0.133)	-0.038 (0.088)	-0.027	1.956		
US 10Y term premium S2P change	0.824*** (0.245)	0.057** (0.022)	-0.028 (0.041)	-0.024 (0.051)	0.002 (0.016)	0.016**	2.231	0.041***	0.047***
US 10Y term premium at start	-0.367 (0.264)	-0.018 (0.019)	-0.013 (0.027)	0.010 (0.026)	-0.009 (0.016)	0.000	-0.764		
US HY corporate spread S2P change	0.150 (0.157)	0.007 (0.009)	-0.030** (0.015)	-0.013 (0.013)	-0.012 (0.006)	0.001	-0.394		0.005
Commodity prices S2P change	0.018 (0.012)	-0.000 (0.001)	-0.002 (0.002)	0.000 (0.001)	-0.000 (0.001)	0.001**	0.032	0.001	
US Breakeven 5Y S2P change	0.237 (0.668)	-0.041 (0.040)	0.023 (0.066)	0.068 (0.050)	0.048 (0.026)	-0.002	-1.383		
SP 500 S2P change	-0.412 (2.684)	0.015 (0.084)	0.389*** (0.142)	0.255 (0.192)	0.217** (0.110)	-0.115**	-10.418	-0.114	
US Citi's macro surprises S2P	0.256 (0.143)	0.004 (0.004)	0.025*** (0.007)	0.015 (0.015)	0.016** (0.007)	-0.000	-0.002		
US GDP growth forecast	6.767 (14.985)	-0.571 (0.947)	0.835 (1.721)	1.785 (1.214)	0.256 (0.813)	0.364	15.248		
US inflation forecast	16.144 (22.353)	-0.510 (1.364)	3.509 (2.841)	-0.593 (2.308)	1.627 (1.351)	0.503	0.822		
US change GDP growth forecast	0.289 (0.276)	-0.010 (0.015)	0.010 (0.024)	0.043** (0.019)	0.003 (0.012)	-0.002	0.459		
US change inflation forecast	-0.003 (0.214)	-0.005 (0.008)	-0.002 (0.020)	0.013 (0.013)	0.009 (0.009))	0.001	0.457		

** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table A.3: Dropping Lehman Brothers aftermath and taper tantrum spikes

	(1)	(2)	(3)	(4)	(5)
	LC yields	Exchange rates	Equity prices	Bonds	Equity
Dummy=1 BEIR-driven spike	26.382 (23.120)	0.399 (0.690)	-1.481 (1.238)	-2.068*** (0.681)	1.159*** (0.324)
Size of spike	3.117 (3.583)	-0.383 (0.248)	0.851** (0.355)	0.143 (0.147)	-0.044 (0.081)
Speed of spike	-6.726 (3.863)	-0.102 (0.126)	-0.834** (0.426)	-0.142 (0.216)	-0.584*** (0.116)
VIX index S2P change	-1.876 (1.811)	-0.077 (0.056)	0.240*** (0.055)	0.380*** (0.043)	0.239*** (0.025)
VIX at start (risk-off)	-0.224 (1.967)	-0.225** (0.108)	0.021 (0.303)	0.049 (0.143)	-0.334*** (0.072)
USD Broad index S2P change	0.217 (5.172)	0.779*** (0.121)	-0.865*** (0.189)	-0.081 (0.063)	0.134*** (0.040)
USD Broad index at start	-4.283** (1.919)	-0.007 (0.038)	-0.108 (0.108)	-0.027 (0.039)	-0.051** (0.024)
US 10Y term premium S2P chg	1.202** (0.479)	0.051*** (0.018)	-0.076 (0.050)	-0.025** (0.011)	-0.012 (0.009)
US 10Y term premium at start	0.216 (0.247)	0.011 (0.011)	-0.004 (0.030)	0.026 (0.018)	0.044*** (0.009)
US HY corporate spread S2P change	0.266 (0.153)	0.018** (0.009)	-0.016 (0.014)	-0.024*** (0.003)	-0.006** (0.003)
Commodity prices S2P change	0.011 (0.010)	-0.001 (0.001)	0.001 (0.002)	-0.002*** (0.000)	-0.001 (0.000)
US Breakeven 5Y S2P change	0.563 (0.548)	0.075** (0.030)	-0.120*** (0.037)	0.097*** (0.016)	0.091*** (0.016)
SP 500 S2P change	-3.978 (3.023)	-0.054 (0.121)	0.622*** (0.135)	-0.020 (0.059)	0.010 (0.066)
US Citi's macro surprises S2P	0.173 (0.284)	-0.026 (0.016)	0.024 (0.034)	-0.022 (0.012)	-0.011*** (0.003)
US GDP growth forecast	25.054** (11.177)	-0.564 (0.439)	0.366 (0.932)	0.162 (0.715)	-1.546*** (0.204)
US inflation forecast	-4.573 (18.907)	0.955 (1.047)	-1.262 (1.670)	1.653 (1.126)	1.584** (0.672)
US change GDP growth forecast	0.226 (0.300)	0.016 (0.009)	-0.033 (0.025)	0.030*** (0.002)	-0.004 (0.004)
US change inflation forecast	-0.203** (0.101)	0.010 (0.008)	-0.021 (0.019)	-0.000 (0.006)	0.022*** (0.003)
EMEs policy rate S2P change	0.058 (0.069)	0.004*** (0.000)	-0.006*** (0.001)	-0.002 (0.001)	-0.001 (0.001)
EMEs appreciation before	0.984 (1.034)	0.028 (0.037)	-0.033 (0.066)	0.029 (0.019)	0.043** (0.018)
EMEs Bond flows before	-0.747 (0.458)	0.037 (0.025)	0.072 (0.092)	0.099*** (0.013)	0.055*** (0.010)
EMEs Equity flows before	0.249 (1.068)	0.083** (0.039)	-0.178 (0.113)	0.000 (0.061)	-0.002 (0.040)
EMEs change S&P rating LC	-14.345 (30.316)	0.098 (0.357)	0.167 (0.993)	-0.295 (0.452)	-0.560 (0.326)
EMEs GDP growth forecast	11.001** (5.224)	0.035 (0.506)	-1.334** (0.655)	0.322 (0.211)	0.038 (0.079)
EMEs Inflation forecast	15.149 (10.060)	0.307*** (0.030)	0.412*** (0.067)	-0.020 (0.048)	0.009 (0.037)
EMEs S&P rating LC	-10.363 (10.450)	-0.056 (0.171)	0.076 (0.533)	-0.114 (0.119)	-0.205 (0.106)
EMEs Reserves to GDP	1.676 (1.697)	-0.025 (0.032)	0.074 (0.141)	-0.089** (0.037)	-0.031 (0.030)
EMEs Current account balance	5.272 (3.191)	0.075 (0.123)	0.363 (0.267)	-0.015 (0.103)	0.024 (0.065)
Obs	428	476	466	476	476

Estimated coefficients shown, followed by standard errors in parentheses. ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table A.4: Alternative algorithm to identify spikes. Summary statistics

	N	Mean	Median	Min	Max
Start to peak change in yield (basis points)	23	92.6	84.3	35.4	213.0
Number of days to peak	23	140.1	129.0	54.0	252.0
Speed (basis points per week)	23	4.9	4.0	2.6	9.3

Table A.5: Model results under alternative algorithm to identify spikes

	(1)	(2)	(3)	(4)	(5)
	LC yields	Exchange rates	Equity prices	Bonds	Equity
Dummy=1 if BEIR-driven spike	-2.450 (18.386)	0.323 (0.946)	1.055 (2.108)	1.591 (1.141)	0.759 (0.898)
Size of spike	7.398 (5.244)	-2.868*** (0.786)	1.394** (0.560)	4.399*** (0.278)	0.528 (0.307)
Speed of spike	1.831 (3.782)	0.611** (0.264)	-4.949*** (0.789)	-2.786*** (0.392)	-1.880*** (0.180)
VIX index S2P change	-1.393 (1.207)	0.374** (0.157)	0.515*** (0.113)	0.721*** (0.122)	0.426*** (0.060)
VIX index at start (risk-on)	1.679 (2.146)	-0.550*** (0.142)	0.705** (0.346)	0.403*** (0.121)	-0.062 (0.128)
USD Broad index S2P change	2.500 (5.046)	3.551*** (0.942)	-0.545 (0.429)	-1.531*** (0.584)	0.759** (0.301)
USD Broad index at start	-3.303 (1.820)	0.159 (0.105)	-0.478*** (0.156)	-0.381*** (0.134)	0.021 (0.030)
US 10Y term premium S2P change	1.097*** (0.306)	0.272*** (0.067)	0.017 (0.040)	-0.179*** (0.033)	0.042 (0.026)
US 10Y term premium deviation at start	0.181 (0.211)	0.140*** (0.037)	-0.106** (0.053)	-0.036 (0.025)	0.018 (0.021)
US HY corporate spread S2P change	0.707 (0.747)	0.172*** (0.056)	0.120** (0.057)	-0.027 (0.039)	0.053** (0.021)
Commodity prices S2P change	0.049 (0.028)	0.001 (0.001)	0.001 (0.002)	-0.005*** (0.001)	-0.001 (0.001)
US Breakeven 5Y S2P change	-1.359** (0.528)	0.580*** (0.182)	-0.191*** (0.062)	0.007 (0.132)	0.273*** (0.066)
SP 500 S2P change	-0.326 (3.164)	-0.123 (0.106)	0.412** (0.181)	0.725*** (0.145)	0.121 (0.065)
US Citi's macro surprises S2P	-0.005 (0.003)	-0.002*** (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.001** (0.000)
US GDP growth forecast	21.079 (14.088)	-9.775*** (2.864)	1.111 (1.190)	2.080 (2.138)	-3.195** (1.357)
US inflation forecast	100.886 (84.047)	13.504*** (3.478)	-22.851*** (4.754)	-13.126*** (1.018)	-3.571 (1.824)
US change GDP growth forecast	1.099** (0.454)	0.029 (0.018)	-0.121*** (0.031)	-0.029*** (0.008)	-0.046*** (0.009)
US change inflation forecast	-0.096 (0.196)	0.033*** (0.010)	-0.016 (0.027)	0.036*** (0.012)	0.040*** (0.012)
EMEs policy rate S2P change	0.061 (0.049)	0.006*** (0.001)	-0.004*** (0.001)	-0.001 (0.001)	-0.000 (0.001)
EMEs appreciation before	1.317 (1.290)	0.080 (0.043)	-0.084 (0.097)	-0.012 (0.039)	0.038 (0.023)
EMEs Bond flows before	0.152 (0.598)	0.034 (0.021)	0.067 (0.128)	-0.014 (0.065)	0.003 (0.012)
EMEs Equity flows before	-0.478 (0.881)	-0.001 (0.043)	-0.081 (0.161)	0.191*** (0.062)	0.137*** (0.030)
EMEs change in S&P rating LC	-11.040 (19.193)	-0.041 (0.395)	0.683 (2.184)	-0.321 (1.017)	-0.278 (0.613)
EMEs GDP growth forecast	17.151*** (6.033)	0.007 (0.609)	-1.523 (0.898)	0.846** (0.367)	0.180 (0.132)
EMEs Inflation forecast	8.451 (10.444)	0.276*** (0.024)	0.431*** (0.088)	-0.079 (0.100)	-0.008 (0.066)
EMEs S&P rating LC	-6.943 (10.930)	0.091 (0.256)	-0.324 (0.750)	0.134 (0.294)	-0.100 (0.167)
EMEs Reserves to GDP	2.408 (1.896)	0.012 (0.038)	0.022 (0.180)	-0.115 (0.098)	-0.071 (0.056)
EMEs Current account balance	3.746 (3.104)	-0.061 (0.157)	0.541 (0.382)	0.101 (0.234)	0.049 (0.092)
Obs	354	391	383	391	391

Estimated coefficients shown, followed by standard errors in parentheses. ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table A.6: Baseline results under alternative way of implementing DS LASSO estimator. 10Y spikes 2004-2022

	(1)	(2)	(3)	(4)	(5)
	LC yields	Exchange rates	Equity prices	Bonds	Equity
Dummy=1 BEIR-driven spike	34.386 (24.488)	0.730 (0.700)	-0.346 (1.324)	-2.449** (0.975)	1.642*** (0.466)
Size of spike	1.697 (5.149)	-0.701** (0.302)	1.141*** (0.384)	0.238 (0.180)	-0.067 (0.086)
Speed of spike	-5.761 (4.136)	-0.175 (0.117)	-0.514** (0.225)	-0.067 (0.173)	-0.570*** (0.089)
VIX index S2P change	-2.521 (1.822)	-0.094 (0.058)	0.372*** (0.100)	0.375*** (0.049)	0.251*** (0.024)
VIX at start (risk-off)	-2.850 (3.590)	-0.302** (0.131)	0.615*** (0.206)	-0.024 (0.168)	-0.390*** (0.076)
USD Broad index S2P change	0.251 (5.216)	0.789*** (0.140)	-0.554 (0.283)	-0.057 (0.059)	0.073 (0.060)
USD Broad index at start	0.653 (1.537)	0.177** (0.080)	-0.443*** (0.108)	-0.048 (0.045)	-0.009 (0.024))
US 10Y term premium S2P change	1.224*** (0.444)	0.093*** (0.022)	-0.120*** (0.026)	-0.045*** (0.013)	-0.003 (0.006)
US 10Y term premium at start	-0.071 (0.156)	0.009 (0.009)	-0.024 (0.016)	0.010 (0.017)	0.034*** (0.006)
US HY corporate spread S2P change	0.155 (0.098)	0.015** (0.006)	-0.048*** (0.008)	0.003 (0.004)	-0.005 (0.003)
Commodity prices S2P change	0.027 (0.019)	-0.001 (0.001)	0.003 (0.002)	-0.003*** (0.000)	-0.001 (0.000)
US Breakeven 5Y S2P change	0.423 (0.596)	0.066** (0.027)	-0.160*** (0.027)	0.127*** (0.014)	0.084*** (0.010)
SP 500 S2P change	-5.146 (3.495)	-0.142 (0.101)	0.543*** (0.141)	0.259*** (0.076)	-0.033 (0.052)
US Citi's macro surprises S2P	0.227 (0.424)	-0.030** (0.015)	0.070*** (0.025)	-0.034** (0.014)	-0.015*** (0.005)
US GDP growth forecast	-2.022 (9.232)	-1.152** (0.501)	2.705*** (0.904)	-0.304 (0.762)	-1.771*** (0.231)
US inflation forecast	-1.327 (23.039)	1.881 (1.117)	-2.686 (1.596)	0.409 (1.152)	1.488** (0.631))
US change GDP growth forecast	0.283 (0.305)	0.018** (0.009)	-0.033 (0.020)	0.039*** (0.003)	-0.003 (0.004)
US change inflation forecast	0.096 (0.190)	0.010 (0.010)	-0.043** (0.020)	0.028*** (0.009)	0.029*** (0.005)
EMEs policy rate S2P change	0.045 (0.044)	0.005*** (0.001)	-0.007*** (0.001)	-0.001 (0.001)	-0.001 (0.000)
EMEs appreciation before	0.218 (1.221)	0.072** (0.031)	-0.084 (0.067)	-0.005 (0.027)	0.016 (0.016)
EMEs Bond flows before	-0.987 (0.652)	-0.013 (0.020)	0.108 (0.089)	0.113*** (0.031)	0.079*** (0.015)
EMEs Equity flows before	0.942 (1.140)	0.021 (0.043)	-0.218** (0.108)	-0.001 (0.049)	0.044 (0.029)
EMEs change S&P rating LC	-9.263 (17.316)	-0.587 (0.407)	0.523 (1.280)	-0.373 (0.501)	-0.157 (0.294)
EMEs GDP growth forecast	12.665 (6.738)	0.301 (0.309)	-1.403** (0.666)	0.421 (0.270)	-0.125 (0.097)
EMEs Inflation forecast	14.012 (7.928)	0.379*** (0.048)	0.354*** (0.050)	0.013 (0.036)	0.012 (0.016)
EMEs S&P rating LC	1.326 (4.062)	0.052 (0.135)	0.482 (0.598)	-0.015 (0.091)	-0.129 (0.068)
EMEs Reserves to GDP	1.209 (1.572)	-0.059 (0.038)	0.150 (0.141)	-0.076** (0.033)	-0.026 (0.029)
EMEs Current account balance	0.986 (2.240)	0.135 (0.116)	0.323 (0.225)	0.063 (0.110)	0.048 (0.051)
Obs	458	510	499	510	510

Estimated coefficients shown, followed by standard errors in parentheses. ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table A.7: Alternative covariate selection estimator: cross-fit partialing out

	(1)	(2)	(3)	(4)	(5)
	LC yields	Exchange rates	Equity prices	Bonds	Equity
Dummy=1 BEIR-driven spike	14.163 (12.823)	0.957 (0.723)	-1.532 (1.779)	-1.975*** (0.659)	0.457 (0.507)
Size of spike	9.652 (7.760)	-0.429 (0.246)	0.883 (0.472)	0.406** (0.195)	-0.064 (0.117)
Speed of spike	-0.288 (2.362)	0.086 (0.108)	-0.944*** (0.283)	-0.111 (0.134)	-0.382*** (0.097)
VIX index S2P change	-1.829 (1.011)	-0.034 (0.053)	0.165 (0.090)	0.389*** (0.041)	0.238*** (0.022)
VIX at start (risk-off)	0.239 (1.985)	-0.009 (0.073)	-0.108 (0.220)	0.197** (0.097)	-0.154** (0.066)
USD Broad index S2P change	3.230 (3.165)	0.794*** (0.113)	-1.152*** (0.265)	-0.150 (0.119)	-0.129 (0.083)
USD Broad index at start	-2.637 (1.431)	-0.037 (0.056)	-0.065 (0.100)	-0.106** (0.042)	-0.061** (0.031)
US 10Y term premium S2P change	1.057*** (0.301)	0.056*** (0.016)	-0.068** (0.027)	-0.071*** (0.011)	-0.029*** (0.007)
US 10Y term premium at start	-0.421** (0.174)	-0.019** (0.008)	0.031 (0.020)	0.010 (0.008)	0.018*** (0.006)
US HY corp. spread S2P change	0.152 (0.124)	0.009 (0.005)	-0.044*** (0.012)	0.005 (0.005)	-0.008*** (0.003)
Commodity prices S2P change	0.029*** (0.010)	0.000 (0.001)	-0.001 (0.001)	-0.002*** (0.001)	-0.000 (0.000)
US Breakeven 5Y S2P change	0.086 (0.432)	0.039** (0.019)	-0.082** (0.032)	0.114*** (0.020)	0.058*** (0.011)
SP 500 S2P change	-1.841 (2.355)	-0.095 (0.075)	0.362** (0.159)	0.188*** (0.072)	0.099** (0.046)
US Citi's macro surprises S2P	0.110 (0.247)	-0.011 (0.010)	0.014 (0.016)	-0.009 (0.009)	0.003 (0.005)
US GDP growth forecast	15.314 (8.949)	0.605 (0.333)	0.249 (0.713)	0.326 (0.373)	-0.517** (0.204)
US inflation forecast	23.499 (16.007)	0.505 (0.804)	1.380 (2.021)	-0.630 (1.009)	0.406 (0.674)
US change GDP growth forecast	0.400** (0.176)	0.010 (0.008)	-0.023 (0.015)	0.023*** (0.005)	-0.000 (0.005)
US change inflation forecast	0.200 (0.198)	0.003 (0.009)	-0.035 (0.020)	0.023*** (0.007)	0.022*** (0.005)
EMEs policy rate S2P change	0.011 (0.083)	0.004*** (0.001)	-0.007*** (0.003)	-0.002 (0.001)	-0.001 (0.001)
EMEs appreciation before	0.616 (1.004)	0.046 (0.037)	-0.061 (0.065)	0.061** (0.025)	0.007 (0.018)
EMEs Bond flows before	-0.464 (0.425)	0.023 (0.021)	0.085 (0.061)	0.084*** (0.019)	0.040*** (0.014)
EMEs Equity flows before	0.471 (1.003)	0.033 (0.037)	-0.211 (0.110)	0.027 (0.041)	0.011 (0.033)
EMEs change S&P rating LC	-23.203 (21.650)	-0.392 (0.566)	0.234 (1.224)	-0.100 (0.462)	-0.377 (0.268))
EMEs GDP growth forecast	5.949 (5.519)	0.067 (0.269)	-0.852** (0.410)	0.616*** (0.213)	0.094 (0.111)
EMEs Inflation forecast	18.884*** (6.869)	0.296*** (0.110)	0.413 (0.247)	-0.019 (0.050)	0.008 (0.033)
EMEs S&P rating LC	-11.785 (10.716)	-0.038 (0.186)	-0.210 (0.350)	-0.004 (0.145)	-0.193 (0.112)
EMEs Reserves to GDP	2.090 (1.449)	-0.002 (0.042)	0.108 (0.104)	-0.107 (0.065)	-0.063** (0.031)
EMEs Current account balance	4.419 (2.619)	0.028 (0.079)	0.510** (0.231)	0.089 (0.087)	0.093 (0.055)
Obs	458	510	499	510	510

Estimated coefficients shown, followed by standard errors in parentheses. ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

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