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Abstract

We assess the importance of economic fundamentals in the transmission of international shocks to financial markets in various emerging market economies (EMEs), covering the so-called taper-tantrum episode of 2013 and seven other episodes of severe EME-wide financial stress since the mid-1990s. Cross-country regressions lead us to the following results: (1) EMEs with relatively better economic fundamentals suffered less deterioration in financial markets during the 2013 taper-tantrum episode. (2) Differentiation among EMEs set in relatively early and persisted through this episode. (3) During the taper tantrum, while controlling for the EMEs' economic fundamentals, financial conditions also deteriorated more in those EMEs that had earlier experienced larger private capital inflows and greater exchange rate appreciation. (4) During the EME crises of the 1990s and early 2000s, we find little evidence of investor differentiation across EMEs being explained by differences in their relative vulnerabilities. (5) However, differentiation across EMEs based on fundamentals does not appear to be unique to the 2013 episode; it also occurred during the global financial crisis of 2008 and, subsequently, during financial stress episodes related to the European sovereign crisis in 2011 and China's financial market stresses in 2015.

Keywords: Emerging market economies, financial spillovers, economic fundamentals, vulnerability index, depreciation pressure, taper tantrum, financial stress.

JEL classifications: E52, F31, F32, F65.

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1. Introduction

Starting in May 2013, on news that the Federal Reserve could soon start tapering its large scale asset purchases (LSAPs), financial conditions in emerging market economies (EMEs) deteriorated sharply. Investors withdrew capital, currencies depreciated, stock markets fell, and bond yields and premiums on credit default swaps rose. This so-called taper-tantrum episode sparked debate on how the rest of the world may be affected—and which economies, especially among the EMEs, may experience the most adverse effects—once the process of U.S. monetary policy normalization set in.

Indeed, one intriguing feature of the "risk-off" episode during the summer and fall of 2013 was that it did not have a similar effect on all EMEs. While some countries experienced acute deteriorations in financial conditions, others were much less affected. The varied experiences of the different EMEs have spawned research on whether the heterogeneous response of EME financial markets during the taper tantrum can be explained by differences in economic fundamentals across these economies. (See, for example: Prachi et al., 2014; Eichengreen and Gupta, 2015; Aizenman, Binici, and Hutchison, 2016; and Sahay et al., 2014.) And, these experiences have also focused attention on whether, more broadly, the effects of U.S. monetary policy shocks on EMEs over a longer period have been related to these economies' own vulnerabilities (Bowman et al., 2015).

In this paper, we seek to contribute to this growing literature by addressing three broad questions: First, to what extent did investors differentiate among the EMEs based on their economic fundamentals during the "risk-off" episode of 2013? Or, can the heterogeneous responses across EMEs be explained by other factors, such as whether those economies that initially received the heaviest capital inflows were also the ones from which investors receded the most during the episode, a possibility raised by some researchers such as Aizenman, Binici, and Hutchison (2016). Second, during the taper-tantrum stress episode, when exactly did differentiation across EMEs begin and how persistent was it? Did investors initially pull back indiscriminately from all EMEs, and then only began differentiating over time as the shock persisted? Or did they discriminate across EMEs from the early stages of the episode? Third, is the differentiation across EMEs by investors a relatively recent phenomenon, or does the

application of our methodology suggest that investors have always distinguished among EMEs, although perhaps to varying degrees, according to their economic fundamentals?

Research to date has not appeared to reach a consensus on the first question—the importance of fundamentals in explaining the heterogeneous EME responses. Using an event study approach, Prachi et al. (2014) analyze the reaction of financial markets to the Federal Reserve's LSAPs tapering announcements in 2013 and 2014, including the episode that we examine in this study. They find evidence of market differentiation among EMEs based on macroeconomic fundamentals. In addition, they find that EMEs with deeper financial markets and tighter macroprudential policy prior to the stress period experienced relatively less deterioration in financial conditions.

In contrast, Eichengreen and Gupta (2015) do not find evidence that better macroeconomic fundamentals—such as a lower budget deficit, lower public debt, a higher level of international reserves, and higher economic growth—provided any insulation. They do find, however, that EMEs whose exchange rates appreciated to a greater degree earlier and whose current account deficits widened more experienced larger effects. But they conclude that the heterogeneous reactions most importantly owed to the size of each country's financial market; larger markets experienced more pressure, as investors were better able to rebalance their portfolios in those EMEs with relatively large and liquid financial markets. Similarly, Aizenman, Binici, and Hutchison (2016) find no evidence that stronger macroeconomic fundamentals helped the EMEs weather the taper tantrum better, but their study focuses only on the very short-term responses of financial indicators after taper news. Classifying EMEs into two categories ("fragile" and "robust") based on their current account balances, levels of international reserves, and external debt, they find that news of tapering from Fed Chairman Bernanke was associated with sharper deterioration of financial conditions in the "robust" EMEs compared with the "fragile" ones in the very short term (24 hours following the announcement). The authors rationalize their results by conjecturing that EMEs with stronger fundamentals received more capital inflows during the expansionary phase of the Federal Reserve's conventional and unconventional monetary policy and accordingly experienced sharper capital outflows and deteriorations in financial conditions on news of an impending tapering. This hypothesis is not explicitly tested in their study, and the authors acknowledge that, over a longer window than they considered in their event study, the fragile EMEs may have suffered more than the robust EMEs after the taper news.

We approach the first question in a somewhat different manner from these previous studies. Rather than looking at market reactions on days when news may be coming in about the Federal Reserve's tapering of asset purchases as Prachi et al. (2014) do, we treat the taper tantrum as a single episode, defined by the observed "peak-to-trough" behavior of financial markets surrounding the period when concerns about tapering came to the forefront. And, unlike Aizenman, Binici, and Hutchison (2016), but consistent with Prachi et al. (2014), we exploit finer cross-section differences in vulnerabilities across the EMEs rather than divide the EMEs into two groups based on the behavior of only three variables. Using a baseline sample of 35 emerging market economies and cross-section regression analysis, we assess the role of economic fundamentals in the heterogeneous cumulative performance of EME financial markets over the whole episode from May 2013 through August 2013.

We find that EMEs that had relatively better fundamentals to begin with—as measured by a host of individual variables capturing vulnerability, or by an aggregate index of relative vulnerabilities across EMEs that we construct—suffered less deterioration during the taper-tantrum episode as measured by a broad range of financial variables, including exchange rate, depreciation pressure, and government bond yields, as well as EMBI and CDS spreads. Our results are consistent with those in Prachi et al. (2014), but contrast with those in Aizenman, Binici, and Hutchison (2016) and Eichengreen and Gupta (2015). We also find that financial conditions deteriorated more in those EMEs that had earlier experienced larger private capital inflows and exchange rate appreciations, consistent with the "more-in-more-out" hypothesis that EMEs that experienced larger inflows prior to the taper tantrum also experienced larger outflows once the episode began, as in Eichengreen and Gupta (2015). However, our results suggest that the strength of economic fundamentals explains much more of the variation in responses across EMEs compared with other factors, such as the previous run-up in capital flows or exchange rate appreciation. Nonetheless, we find very little evidence that the structure of the financial markets—such as the size of the capital market, the level of foreign investor participation, or the extent of capital account openness—shaped the heterogeneous responses of financial markets.

On the second question, related to the timing and persistence of differentiation, the conventional wisdom seems to be that early in the taper tantrum, investors did not differentiate much among EMEs according to their vulnerabilities, but such differences emerged when concerns about tapering persisted. (See, for example, Sahay et al., 2014.) However, our evidence

suggests that differentiation according to relative vulnerabilities set in relatively early during the stress episode and persisted at least for the duration of the stress episode, although the extent of differentiation was less pronounced in the first few weeks.

Turning to the third question of the extent to which investors also discriminated among EMEs during other stress episodes, we use our methodology to identify seven other episodes of severe financial stress in the EMEs over the past 20 years: the Mexican crisis (1994-95), the Asian crisis (1997-98), the Russian crisis (1998), the Argentine crisis (2002), the global financial crisis (GFC, 2008-09), the European sovereign debt crisis (2011), and China's recent financial market stresses (2015). For each of these episodes, we examine the role of economic fundamentals in driving any heterogeneous cumulative reaction of asset prices over the full episode across EMEs.[2] We find little evidence of differentiation based on economic fundamentals in the 1990s and the early 2000s. However, the results also suggest that differentiation was not unique to the taper tantrum in 2013. In fact, it appears that fundamentals played a role in explaining the heterogeneous reaction of EME asset prices during the GFC in 2008, and that they continued to play a similar role during subsequent stress episodes. These results—that differentiation has occurred among EMEs since the GFC—are consistent with those from a complementary approach taken in Bowman et al. (2015). Identifying monetary policy-related shocks to U.S. interest rates, rather than episodes of severe financial stress as we do, they find that the effect of such shocks on EME interest rates have been larger in the relatively more vulnerable EMEs in the recent past as well, and that there is no difference in this respect between the effects of conventional and unconventional U.S. monetary policy.

Taken at face value, our results suggest that international investors may have moved from no differentiation in the past—such as during the 1990s and the early 2000s—to progressively differentiating more and more among EMEs according to their economic fundamentals through the GFC and the subsequent episodes of financial stress. Thus, our results contribute to the literature debate on whether cross-country contagion in the event of a crisis is purely the result of investors' behavior versus a result of differences in trade and financial links as well as macroeconomic fundamentals (see Dornbusch et al., 2000, for a review). On one hand, our result

[2] In a related paper, Davis and Zlate (2016) explore the link between financial performance and macroeconomic fundamentals in EMEs not only during episodes of financial stress, but more generally during crisis and non-crisis times over the financial cycle.

of no differentiation during the early stress episodes is consistent with the explanation that investors' behavior facilitated contagion during those events. For instance, liquidity problems caused by losses in one country may have promoted investors to sell off securities in other EMEs, regardless of the strength of their fundamentals (see Pritsker, 2000; Kodres and Pritsker, 2002). Also, a high fixed cost of gathering information in the presence of information asymmetries may have led to herd behavior and contagion (Calvo and Mendoza, 2001). On the other hand, the result of increased differentiation since the GFC lends support to the literature emphasizing the role of trade and financial linkages as well as macroeconomic fundamentals (for example, see Corsetti et al., 1999; Forbes and Chinn, 2004; Bekaert et al., 2014; and Aizenman Chinn, and Ito, 2016). However, more research is needed to understand the factors driving this apparent shift toward differentiation during the past decade. The gradual improvement and changing relevance of the EMEs' macroeconomic fundamentals, the faster dissemination of knowledge on individual EMEs' characteristics due to better and more timely data, and the increasing degree of the EMEs' integration with world financial markets are factors likely to have facilitated differentiation by foreign investors. Nonetheless, it remains an open question whether our results are perhaps driven by different sources of the shock. Most stress episodes since the GFC, during which we find evidence of differentiation among EMEs, emanated primarily from the advanced economies.[3] In contrast, the crises of the 1990s and 2000s, during which we find no evidence of differentiation, emanated to a much larger extent—although not exclusively so—from shocks originating in the EMEs themselves.

The remainder of the study is organized as follows: In section 2, we describe the data and the estimation strategy. Then, section 3 presents our results of differentiation across EMEs during the 2013 taper-tantrum episode, and section 4 shows the results for differentiation in previous well-recognized EME financial stress episodes. Section 5 concludes.

2. Econometric specification and choice of variables

For each EME stress episode identified, we regress performance in selected financial markets across EMEs over the duration of the stress period on a set of variables capturing economic

[3] The turbulence associated with China's financial markets stresses in 2015 is one exception.

conditions that existed prior to the beginning of the stress episode and other control variables. Our cross-section regression is represented by the following equation:

$$\Delta FinVar_i = c + \sum_j \beta_j X_{i,j} + \varepsilon_i \qquad (1)$$

Note that each *i* denotes a particular country, and we use multiple financial indicators to build the dependent variable in alternative specifications, with the change in each indicator represented by Δ measuring financial performance over the stress episode. $X_{i,j}$ are a set of explanatory variables *j* specific to country *i* measured in the year prior to the onset of the stress period, β_j are parameters to be estimated, and ε_i are error terms. Note that the cross-section observations in each regression are the countries, and a separate regression is run for each dependent variable and each sub-set of explanatory variables *j*.

Among the dependent variables measuring financial performance, we consider the percent change in the country's bilateral nominal exchange rate against the dollar, the change in the local currency bond yields on 10-year government bonds, the percent change in the stock market index, and the change in EMBI and CDS spreads between the peak and trough of each episode (for example, from April to August for the 2013 episode) using monthly data. Pressures on financial markets may not necessarily be reflected in the exchange rate if the central bank intervenes in foreign exchange markets to prop up the currency or raises the policy rate to contain capital flight. For this reason, we also consider a depreciation pressure index that is a weighted average of the change in the exchange rate and the foreign exchange reserves, following Eichengreen et al. (1995), with the weights given by the inverse of the standard deviation of each financial indicator measured in the cross section.[4]

We consider several different types of independent variables: those that might be capturing the macroeconomic fundamentals and policy choices of a country (category 1), those that might help identify how much capital might have been flowing in prior to the episode so we can test the "more-in-more-out" hypothesis (category 2), and those that might be capturing aspects of a country's financial structure such as openness and financial development (category 3), which are included as other control variables.

[4] Alternatively, we also constructed a depreciation pressure index based on the changes in exchange rates, foreign exchange reserves, and the policy rates between April and August 2013. Since the two indexes behave similarly during the taper-tantrum episode, our results are mostly based on the standard depreciation index based on changes in exchange rates and reserves only.

Potential candidates for category 1 include the following six variables reflecting the strength of macroeconomic fundamentals: the current account balance as a percent of GDP; foreign exchange reserves as a percent of GDP; short-term external debt as a percent of foreign exchange reserves; the gross government debt as a percent of GDP; the average annual inflation over the past three years; and the run-up in bank credit to the private sector, measured as the change in the ratio of bank credit to GDP over the five years prior. To mitigate concerns over endogeneity, each of these is taken as of the year prior to the one in which the episode occurs. For the 2013 event, we also use the revisions to the economic outlook as an additional variable capturing fundamentals, measured as the change between January and May of 2013 in the outlook for annual average real GDP growth for 2013 provided by Consensus Economics. Finally, we account for the monetary policy and exchange rate frameworks through two indicator variables, with the first variable equal to 1 for countries operating under an inflation targeting regime and 0 if not, and the second variable equal to 1 for countries with floating exchange rate regimes and 0 otherwise, based on the classification in the IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions. Given the relatively small cross-section, not all of these variables can be included simultaneously; we consider individual variables one at a time and sub-sets of them. We also compute an aggregate index of relative vulnerabilities across the cross-section using some of these variables in light of the limited number of observations; this vulnerability index is described in detail later. In robustness checks, we also replace the vulnerability index with principal components based on the six macroeconomic indicators used to construct the vulnerability index.

For category 2, we include the following variables: the cumulative gross capital inflows over the past three years as a percent of GDP and the appreciation of the real effective exchange over the past four years. For category 3 variables, we consider the capitalization of the domestic equity market as a share of GDP; foreign participation in the domestic equity market, measured as the share of foreign equity holdings in the domestic equity market; and capital account openness as measured by the Chinn-Ito index, a de jure measure of financial openness initially introduced in Chinn and Ito (2008) and subsequently updated by the authors through 2011. For each of these indicators, the data sources are presented in Table 1.

The "baseline" sample includes up to 35 EMEs.[5] Since data availability varies across indicators, countries, and time, the exact sample size differs across specifications. For the taper tantrum episode, for instance, the sample includes 35 EMEs when the depreciation pressure index is the dependent variable, and 24 EMEs when the change in government bond yields is the explanatory variable.

3. Differentiation across EMEs during the 2013 taper-tantrum episode

This section provides an overview of the taper-tantrum episode of 2013, presents new evidence on the drivers of EME differentiation for the entire duration of the episode, and discusses the timing and persistence of differentiation within sub-intervals of the episode itself.

3.1 Overview of the episode

Market participants shifted their expectation for the Federal Reserve's asset purchases program following former Chairman Bernanke's testimony to the Congress on May 22. The testimony heightened perceptions that the Federal Reserve would soon begin tapering its LSAPs and thus lessen the amount of monetary stimulus it was putting into the economy through its unconventional monetary policies. This shift in market expectations led to sharp movements in U.S. and global financial markets, including a large sell-off of EME assets by international investors, causing large depreciations of currencies, increases in bond yields, EMBI spreads, and CDS spreads, as well as declines in equity markets. As shown in Table 1, for the average EME in our sample, the dollar exchange rate depreciated 5.4 percent, sovereign bond yields rose almost 1 percentage points, the stock market fell 0.8 percent, and the EMBI and CDS spreads each rose almost 0.5 percentage point from April to August. In response, central banks in some EMEs intervened in the foreign exchange markets to curb depreciation pressures, which resulted in losses of foreign exchange reserves, and also, in some cases, raised policy rates to discourage capital flight. The stress episode persisted for much of the summer, until the Federal Reserve chose not to reduce the size of its asset purchases at the September 2013 Federal Open Market

[5] These 35 EMEs are: China, India, Indonesia, South Korea, Malaysia, the Philippines, Taiwan, Thailand (Emerging Asia); Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Moldova, Poland, Russia, Serbia, Ukraine (Emerging Europe); Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Paraguay, Peru, Uruguay (Latin America); and Israel, Kazakhstan, Pakistan, Saudi Arabia, South Africa, and Turkey (Other).

Committee meeting. Thus, we date the taper tantrum episode from May to August and compute the change in financial indicators relative to April, consistent with the literature.

Although most financial markets in EMEs were negatively affected during the taper tantrum, there was wide dispersion in the financial performance across EMEs, as shown by the histograms in Figure 1. As can be seen in panel 1, although most EME currencies depreciated between 0 and 10 percent, the extent of depreciation did vary quite a bit, with a few currencies having appreciated mildly, and others having depreciated more than 15 percent. The use of foreign exchange rate intervention also appeared to vary across EMEs (panel 2). The heterogeneous response is also apparent in the depreciation pressure index that combines changes in the exchange rate and foreign exchange reserves (panel 3), with most EMEs experiencing depreciation pressure. Similarly, most EMEs experienced increases in sovereign bond yields and EMBI spreads (panels 4 and 6), while the performance of equity markets was more mixed across EMEs (panel 5).

With U.S. interest rates expected to rise, some effect on the EMEs was to be expected for several reasons. For example, rising U.S. rates encourage investors to shift their holdings toward U.S. assets (see Ahmed and Zlate, 2014). At the same time, investors may withdraw funds during risk-off episodes especially from those EMEs perceived to be more risky. Indeed, although the movements in most EME financial markets were sizable, investors did not appear to withdraw funds indiscriminately from all EMEs, as shown in Figure 1. Therefore, we next turn to the question of whether the varied response of EME financial markets during the taper tantrum episode was systematically related to their economic fundamentals.

3.2 Differentiation across EMEs during the 2013 stress episode as a whole

As a first cut to examining this issue, we present some scatter plots capturing bivariate relationships. Figure 2 plots the depreciation pressure index across EMEs during the episode (on the vertical axis) against six potential variables (on the horizontal axis in the different panels) that investors may care about when assessing a country's macroeconomic fundamentals. Judging by the R-squares and the statistical significance of the slope coefficients presented under each panel, the figure suggests that the EMEs that encountered more depreciation pressure also had larger current account deficits as a share of GDP (panel 1), less reserves-to-GDP (panel 2),

higher gross government debt ratios (panel 4), and higher average inflation over the past few years (panel 5). There seems to be a weaker link between depreciation pressure and the share of short-term external debt in reserves (panel 3) or the run-up in bank credit to the private sector as a ratio to GDP (panel 6).

Figure 3 does a similar exercise of linking individual macroeconomic variables to the performance of bond markets, specifically the rise in local currency government bond yields during the taper tantrum. The results obtained are generally consistent with those found in Figure 2. Bond yield increases were greater in economies with greater current account deficits, less reserves, higher short-term debt, higher average inflation, and a larger run-up in credit to the private sector.

3.2.1 The role of macroeconomic fundamentals

To further understand the drivers of the heterogeneous performance of EME financial markets, we estimate equation (1) using explanatory variables from the three categories described in section 2, that is, first, those describing the strength of macroeconomic fundamentals, the growth outlook, and the policy framework; second, those relevant for the "more-in-more-out" hypothesis; and third, those describing the structure of financial markets.

We find that macroeconomic fundamentals were important drivers of the heterogeneous performance of EME financial markets during the taper tantrum episode, as was suggested by the scatter plots shown earlier. In the multivariate regressions in Tables 2 through 4, three of the six variables considered to describe the strength of macroeconomic fundamentals (that is, foreign exchange reserves, inflation, and credit growth) are statistically significant in explaining the behavior of various EME financial indicators. (In the univariate regressions in Figures 2 and 3, five of the six variables are statistically significant). As shown in Table 2, the EMEs with higher inflation and a larger run-up in bank credit suffered more severe currency depreciations (column 1) as well as higher depreciation pressure relative to the dollar (column 8). A lower stock of foreign exchange reserves also resulted in more depreciation pressure. All else equal, an additional 1 percentage-point increase in bank credit relative to GDP was associated with 0.17 percentage point greater depreciation. In Table 3, the EMEs with lower foreign exchange reserves and faster previous run-ups in bank credit suffered larger increases in bond yields (column 1). Similarly, EMEs with faster previous run-ups in bank credit suffered greater

declines in equity prices during the episode (column 8). On average, EMEs with 10 percentage points less reserves relative to GDP suffered 29 basis points larger increases in bond yields compared to their peers; an additional 1 percentage-point previous increase in bank credit relative to GDP was associated with 0.39 percentage point greater declines in equity prices during the event. Nonetheless, in Table 4, EMEs with lower foreign exchange reserves suffered larger increases in EMBI spreads (column 1), while those with greater inflation experienced greater increases in their sovereign CDS spreads (column 8).

Unsurprisingly, not all of the six macroeconomic variables are statistically significant in explaining the behavior of each financial indicator. Some macroeconomic characteristics should be more relevant for certain types of financial assets than others. In addition, while the coefficients tend to have the expected signs, their statistical significance is likely constrained by the limited degrees of freedom in multivariate cross-sectional regressions with a relatively small sample and by some likely interdependence between the variables. For example, although the scatter plots in Figure 2 suggest that four of the six macroeconomic variables affected the extent of depreciation pressure during the stress episode, three of these six variables (foreign reserves, inflation, and credit) are statistically significant in the multivariate regression in Table 2 (column 8); notably, while credit is not statistically significant in univariate regressions, it becomes so in the multivariate regressions in Table 2. Also, while the current account deficit is statistically significant in bivariate regressions for depreciation pressure, the increase in bond yields, and the increase in EMBI spreads (not shown), it is not statistically significant in the multivariate regressions in Tables 2-4.

However, given that each of the six macroeconomic variables has a role in explaining some aspect of financial performance—in either bivariate or multivariate regressions—in what follows we will consider them jointly in our baseline assessment of the link between macroeconomic fundamentals and differentiation across EMEs financial markets during the taper-tantrum episode.

3.2.2 The vulnerability index

To better understand the determinants of financial market performance, we build an index of EME vulnerabilities that summarizes the relative strength of EMEs' macroeconomic fundamentals based on the six variables discussed in section 2, given their importance in shaping

the financial market responses. The vulnerability index has the advantage of aggregating the information embedded in multiple macroeconomic variables while addressing the problem of limited degrees of freedom in our multivariate regressions.

To construct the index, we first rank the EMEs relative to each other according to each variable, from lowest vulnerability to highest vulnerability. We then take the average ranking of a country across the six variables to obtain the value of the index for each EME, with higher values representing higher vulnerability. Specifically, the index is obtained as follows:

1. For each of the six macroeconomic variables, we rank countries from 1 to *N* (the number of countries in the sample), with a higher ranking indicating greater vulnerability. For example, for gross government debt-to-GDP, the country with the highest ratio has a rank of *N* and the country with the lowest ratio has a rank of 1. Similarly, for the current balance variable, the country with lowest current account balance-to-GDP ratio gets a rank of *N* and a rank of 1 is assigned to the country with the highest ratio.

2. After the rankings are assigned based on each of the six variables, we obtain six rankings for each country, i.e., one ranking for each macroeconomic indicator. Importantly, the index is computed only for countries with data available for each of the six indicators.

3. Finally, we compute the overall ranking (or index) for each country *i*, obtained by averaging the country's six rankings. Since the relatively less vulnerable countries are ranked at the top (i.e., ranking orders of 1, 2, 3, etc.), lower values of the index reflect relatively lower vulnerability.

4. A separate index is computed for each year by repeating steps 1, 2, and 3 for that year. It is important to note that this index represents relative vulnerabilities across EMEs at a point in time and not the absolute levels of vulnerabilities.

Simple estimates from univariate regressions show positive and statistically significant relationships between the vulnerability index as the sole explanatory variable and, alternatively as the dependent variable, the exchange rate depreciation (Table 2, column 2), the depreciation pressure index (Table 2, column 9), and the increase in government bond yields (Table 3, column 2). Notably, there are also positive and statistically significant links between the vulnerability index and the increases in the EMBI spreads and CDS spreads (Table 4, columns 2 and 9).

However, we do not find a statistically significant link between the vulnerability index and changes in stock prices (Table 3, column 9).

To test whether the limited degree of freedom due to small sample size is affecting our results, we expand the sample from 35 to 64 countries and find a similar role for the vulnerability index as a predictor of financial performance. Expanding our sample is constrained by data availability, i.e., it is feasible for depreciation pressure and the vulnerability index; however, data limitations apply to the more-in-more-out and financial structure variables discussed next, and also to earlier episodes of financial stress. In addition, expanding the baseline sample calls into question the EME versus developing economy status of the new countries. Subject to these caveats, the scatterplot and univariate regression results for the extended sample are reported in Figure 4 (panel 2). Just like in the baseline sample (panel 1), the slope coefficient shows a positive and statistically significant relation between depreciation pressure and the vulnerability index for the extended sample of 64 countries.

In an additional robustness check, we use principal component analysis instead of the vulnerability index to explain the variation in financial performance across EMEs. The principal component analysis takes into account the correlation among the six macroeconomic indicators used to construct the vulnerability index, and produces variables (i.e., the principal components) that are linearly uncorrelated. When used as explanatory variables instead of the vulnerability index, the first three principal components are statistically significant in most specifications and explain about as much of the variation in financial variables as the vulnerability index. This is the case for exchange rates and the depreciation pressure index (Table 2, see columns 2 vs. 7, and columns 9 vs. 14), the change in bond yields (Table 3, columns 2 vs. 7); and the change in EMBI and CDS spreads (Table 4, columns 2 vs. 7, and columns 9 vs. 14).

3.2.3 The role of other variables

While using the EME vulnerability index to summarize the strength of macroeconomic fundamentals, we also explore the role of additional variables in explaining the heterogeneous response of EME financial markets during the taper-tantrum episode.

First, we do not find evidence that the performance of EME financial markets was linked to changes in EMEs' growth outlook prior to the episode. Changes in economic growth prospects should, a priori, be an important determinant of financial market performance. The fact that the

analysis does not find a prominent role for it might be due to measurement and timing issues. In addition, we find inconclusive evidence that the EMEs with inflation targeting or floating exchange rate regimes suffered less deterioration in financial markets than otherwise. Thus, it appears that EME floaters experienced more depreciation (Table 2, column3), but benefited from lower rises in bond yields and CDS spreads (Table 3, column 3 and Table 4, column 10). The EMEs with inflation targeting regimes seem to have suffered larger increases in bond yields and larger drops in equity prices (Table 3, columns 3 and 10), but not for other financial indicators.

Second, controlling for the influence of macroeconomic fundamentals, we find some evidence to support the "more-in-more-out" hypothesis for exchange rates and bond yields—that is, the EMEs that received more capital inflows or experienced more exchange rate appreciation prior to the episode suffered greater deteriorations in financial conditions during the episode itself. As shown in Table 2, countries that received more private gross inflows (column 4) or had more real effective appreciation previously (column 5) also experienced more depreciation during the episode. In Table 3, countries that experienced more appreciation previously also suffered greater increases in bond yields (column 5) and greater declines in the stock market index (column 12) during the episode. In Table 4, countries that received more gross inflows (column 11) or experienced more appreciation previously (column 12) also suffered greater increases in the sovereign CDS spreads. All in all, the results confirm that, although the volatility of capital inflows during boom-bust cycles may have weighed on the EME financial markets during the taper tantrum, those countries with stronger fundamentals were better prepared to sustain the financial turbulence brought by the episode.

Third, while controlling for macroeconomic fundamentals, we find very little evidence that the EMEs' financial performance during the taper tantrum was related to the structure of financial markets. Those EMEs with greater capital account openness seem to have experienced less depreciation pressure (Table 2, column 13), while the EMEs with greater market capitalization appear to have suffered more exchange rate depreciation (Table 2, column 6). However, we do not draw any strong conclusion about the role of financial market structure, given that the results seem to hold in just a few isolated cases.

Notwithstanding the role of these other factors, we find our relative vulnerability index across the EMEs to be a very robust summary statistic explaining heterogeneous responses

across EMEs during the taper tantrum. In the univariate specifications in which the vulnerability index is statistically significant (see Tables 2 through 4, columns 2 and 9), the vulnerability index explains more of the variation of the dependent variable than any of the other explanatory variables taken individually. For example, the vulnerability index explains 42 percent of the variation in depreciation pressure during the taper tantrum episode (Table 2, column 9). In contrast, the cumulated gross capital inflows or the real effective exchange rate appreciation alone (not shown) explain only 14 and 6 percent of the variation. Similarly, for the change in bond yields, the vulnerability index explains about 52 percent of the variation, while gross inflows and the real effective exchange rate explain only 24 and 4 percent respectively.[6] These results suggest that the strength of economic fundamentals explains substantially more of the variation in financial performance across EMEs compared with factors such as the "more-in-more-out" variables.

3.3 Timing and persistence of differentiation across EMEs within the 2013 episode

We next explore the timing and persistence of differentiation among EMEs during the episode of financial stress that started in May 2013. To this end, we use two measures of financial performance, one cumulative and another one incremental. First, for the cumulative measure, we keep the basis of comparison fixed in April 2013 and take windows of varying lengths (in months) up to December (that is, windows that end successively between May and December 2013). We compute the financial performance of EMEs for each of these windows and explore the link with the vulnerability index described earlier. Second, for the incremental measure of financial performance, we take the month-to-month changes in EME financial indicators for the entire duration of the stress episode (that is, the first window is April to May of 2013; the last window is November to December 2013).

The results suggest that the differentiation across EMEs started relatively early in the stress period and persisted even after the episode ended, although the degree of differentiation eased in the later months of the episode. In Table 5 (column 1 of either the top or bottom panel), the results show a positive and statistically significant link between the depreciation pressure index

[6] A similar pattern holds for the change in EMBI spreads and CDS spreads, for which the vulnerability index, gross inflows, and real effective exchange rate appreciation explain about 39, 9, and 8 percent, and respectively 31, 24, and 23 percent of the variation.

(the dependent variable) and the vulnerability index (the explanatory variable) even over the end-April to end-May period, suggesting that differentiation set in early when the taper-tantrum episode began in late May. Computing the depreciation pressure cumulated over windows of different lengths in the top panel, the differentiation among EMEs according to the vulnerability index persisted not just throughout the stress period, but also for at least several months after the episode ended. For the incremental depreciation pressure in the bottom panel, most of the differentiation occurred in May, June, and August (columns 1, 2, and 4).

Similarly, as shown in Table 6, there was a positive and statistically significant link between the cumulative increase in local currency bond yields (the dependent variable) and the vulnerability index starting in June 2013, and the link persisted until at least December (top panel). For the month-to-month increase in yields (bottom panel), most of the differentiation occurred in June, July, and August (columns 2, 3, and 4). While some of the differentiation was reversed later in October (column 6), when the coefficient switches signs, suggesting that the most vulnerable EMEs retraced some of their previous increases in bond yields, there was a renewed bout of deterioration in November and December (columns 7 and 8).

In sum, these results are consistent with the interpretation that investors adjusted their portfolio exposure by differentiating against the relatively more vulnerable EMEs and did not fully reverse this adjustment several months after the stress episode ended.

4. Differentiation across EMEs during past stress episodes

In this section, we assess whether the differentiation across EMEs according to macroeconomic fundamentals was a development specific to the 2013 taper tantrum episode, or whether any differentiation across EMEs during past episodes of financial stress is also explained well by differences in their vulnerabilities.

To address this question, we first develop a methodology to identify historical events of financial stress going back to the 1990s. Second, taking the identified start and end dates for each historical event as given, we construct the EME vulnerability index for the year prior to each event using the methodology in section 3.2.2, and also construct measures of financial performance during the event using the month prior to the start date as the basis of comparison.

Finally, we examine how the link between macroeconomic fundamentals and financial performance has evolved over time.

4.1 Identification of past stress episodes

To identify stress events, we look for outsized movements in three broad indicators that characterize financial markets in the EMEs. Specifically, we search for: (1) unusually large increases in VIX, which serves as a proxy for perceived risk and global risk aversion; (2) unusually large depreciations in an aggregate index of EME currencies against the dollar; and (3) unusually large declines in the MSCI equity index for the EMEs.[7] Generally, we define an episode of financial stress occurring when at least two of the three indicators display unusually large movements over the same period.

Figure 5 shows the three aggregate financial indicators for the EMEs at the weekly frequency starting in 1990. To identify unusually large movements in each of the three indicators along with the corresponding peak and trough dates, we use the following algorithm. First, for the VIX, we compute its deviations from a Hodrick-Prescott trend fitted over the interval from 1990 to 2016. To identify possible episodes and their duration, we select all consecutive observations in which the VIX was at least two standard deviations above the trend; when these observations are immediately preceded or followed by values that were at least one standard deviation above the trend, we include these other observations in the event as well. The first and last dates of each VIX-determined event are considered as intervals for the episodes.

Second, for the aggregate index of EME currencies, we compute the percent change in the index relative to the maximum value recorded over the previous six months, and select instances when the depreciation was 4.5 percent or more. We select the trough as the end date (that is, the week of maximum depreciation relative to the six-month maximum), and the maximum as the start date for each possible event.

Third, for the MSCI stock market index, we also compute the percent change in the index relative to the maximum recorded over the previous six months, and focus on instances when the decline was 10 percent or more. As in the case of exchange rates, we select the trough as the end

[7] Specifically, we use the Federal Reserve Board's U.S. trade-weighted aggregate nominal index of the dollar against a number of EMEs.

date (that is, the week of maximum decline), and the maximum as the start date for each possible event. Finally, we consider the dates of events indicated by each of the three measures, and focus on instances in which at least two of the three indicators point to overlapping events.

Based on this methodology, we identify 14 episodes of financial stress in the EMEs going back to 1990, which are illustrated by the shaded areas in Figure 5 (in either grey or blue). Out of these, we judgmentally choose a sub-set of eight events (in blue) that are associated with well-known episodes of financial stress, including: (1) the Mexican crisis, from September 1994 to March 1995; (2) the Asian crisis, from July 1997 to January 1998; (3) the Russian crisis, from August to November 1998; (4) the aftermath of the Argentine crisis, from April to October 2002; (5) the GFC, from September 2008 to February 2009; (6) the European sovereign debt crisis, from July to December of 2011; (7) the 2013 taper tantrum from May to August of 2013;[8] and (8) China's financial market stress from July to September of 2015.

4.2 Did economic fundamentals matter during past stress episodes?

We estimate univariate regressions based on equation (1) for the eight historical episodes during which EME financial conditions deteriorated significantly. The sole explanatory variable, the vulnerability index, is computed based on the six macroeconomic variables discussed in section 2, using values for the year preceding each stress episode. The dependent variable, the depreciation pressure index, is based on changes in exchange rates and losses in foreign exchange reserves measured from the month prior to the start date to the end month of each event. Given the shifts in exchange rate regimes over time, it is important that we use the depreciation pressure index rather than just the exchange rate depreciation to measure financial performance during the 1990s. For instance, the EMEs with heavily managed exchange rate regimes may have experienced less depreciation during a stress episode (that is, barring a devaluation), which would have falsely indicated resilience of their currencies; the depreciation pressure index solves this problem by also taking into account the loss in reserves required to maintain the managed float during a crisis episode. Finally, for each episode, we exclude the EMEs at the epicenter of each crisis given their status as outliers (that is, Mexico in 1994,

[8] We include the taper-tantrum episode again with this endogenous dating of the episode, which picks out May to August as the dates for the episode, consistent with what we chose in section 3.1.

Indonesia, Malaysia, the Philippines, South Korea, and Thailand in 1997, Russia in 1998, Argentina and Uruguay in 2001, and China in 2015).

The results for the depreciation pressure index are presented in Figure 6 and Table 7 (top panel). Figure 6 shows scatter plots between the vulnerability index (on the horizontal axis) and the depreciation pressure index (on the vertical axis) for each of the eight historical episodes along with the regression lines, while Table 7 provides more detailed results for the corresponding univariate regressions. From Figure 6, it appears that while there was some heterogeneity in the financial market performances during the EME crises of the 1990s and the early 2000s, the ability of macroeconomic fundamentals (as measured by our relative vulnerability index) to explain this heterogeneity was weak (panels 1 through 4). However, judging from the increasingly close alignment between vulnerability and depreciation pressure, differentiation appears to begin with the GFC in 2008-09, then strengthens during the European sovereign debt crisis in 2011, strengthens even more during the 2013 taper tantrum, and remains considerable during the 2015 China episode (panels 5 through 8). The results in Table 7 (top panel) confirm this: the vulnerability index is not statistically significant and the R-squared values are very low for the Mexican crisis in 1994 through 1995 (column 1), the Asian crisis in 1997 (column 2), the Russian crisis in 1998 (column 3), and the Argentine crisis in 2002 (column 4). However, the vulnerability index became statistically significant during the GFC in 2008 (column 5) and remained statistically significant during the subsequent events (columns 6-8).

We find similar results for the link between the vulnerability index and the increase in sovereign bond yields for recent stress episodes for which data are available (Figure 7). While the sample size is restricted by data availability, we see little evidence of differentiation during earlier episodes (panels 1-3), but we see a pattern of differentiation during the 2013 taper tantrum and China's 2015 financial stress (panels 4 and 5). The corresponding coefficients in Table 7 (the middle panel) have little or no statistical significance for the earlier episodes (columns 4-6), but are positive and statistically significant for the latter two episodes (columns 7 and 8). Finally, we find little evidence of differentiation for changes in stock market prices (not shown). Also, we could not perform a similar exercise for the increase in EMBI spreads and CDS spreads due to the limited availability of historical data.

Andrews (2003, 2005) highlights that common shocks may have a differentiated impact across observations in cross-section regressions, which could lead to cross-sectional dependence and could affect the consistency of coefficient estimates. In our empirical setup, for example, this issue may occur if a stress episode has a differentiated impact on the financial performance of countries despite similar macroeconomic fundamentals, with the impact varying discretely across country groups or continuously with unobserved country characteristics. To ensure that cross-sectional dependence is innocuous for our results—i.e., that the errors have mean zero, are uncorrelated with country characteristics, and/or are independent across country groups—we regress of depreciation pressure on the vulnerability index in a pooled sample of countries and events. Given the panel structure of the pooled sample, we are able to use country and group fixed effects to control for the possibly differentiated impact of common shocks across individual countries or country groups (e.g., Emerging Asia vs. Latin America vs. Emerging Europe, and commodity exporters vs. non-exporters), which otherwise may have been included in the error terms. By choosing these groupings, we impose a likely structure on the potential cross-sectional dependence that appears plausible for our sample countries.

In Table 7 (bottom panel), the results support the original findings. They correspond to panel regressions where the sample of countries is pooled across the four stress episodes "before GFC" (1995-95, 1997-98, 1998, and 2002) and "during and after GFC" (2008, 2011, 2013, and 2015). In columns 1-2, in the presence of country and episode fixed effects, the vulnerability index coefficient is positive and statistically significant for during and after the GFC, but not for the earlier events. In addition, the result also holds in the presence of fixed effects for regions (i.e., Emerging Asia, Latin America, Emerging Europe, and Other, in columns 3-4), or for the group of commodity exporters vs. non-exporters (columns 5-6), following the classification in World Bank (2017). Nonetheless, the result also holds when the slope coefficients are allowed to vary across the same country groups (Table 8); namely, they are positive and statistically significant for during and after GFC, but not before. Because our results hold in the pooled sample regressions, we believe that cross-sectional dependence is likely innocuous for our original results.

In sum, it is noteworthy that macroeconomic fundamentals have gained increasing importance in recent years in explaining differences in financial pressures across EMEs during episodes of heightened financial stress. However, more research is needed to fully understand the

factors explaining this apparent shift in behavior. There are at least two main hypotheses. On one hand, the increasing degree of integration of EMEs with world financial markets, the improvement in macroeconomic fundamentals (to varying degrees across EMEs), and better knowledge of individual EMEs' characteristics (perhaps made easier by technological advances and improvements in data quality) could have facilitated differentiation across EMEs. On the other hand, the shifting nature of the shocks that triggered stress events could also be a potential contributing factor to the rise in differentiation over time. While the financial crises before the GFC had originated mainly in the EMEs themselves (for which we find little evidence of differentiation by investors being related to economic fundamentals), the more recent episodes of financial stress were triggered mostly by events originating in the advanced economies (when differentiation by investors is explained by differences in economic fundamentals).[9] The 2015 episode, when differentiation occurred again even through the event originated in China rather than in advanced economies, somewhat mitigates this concern. However, it is an issue for future research whether the EMEs' remoteness from the origins of financial stress lends itself to investors discriminating more across EMEs according to their economic fundamentals.

5. Conclusion

The taper-tantrum episode was triggered by a shift in May 2013 in market perceptions regarding the prospects for LSAPs by the Federal Reserve. It is important to understand the implications for the global economy, and particularly for the EMEs, that arise from evolving expectations of monetary policy actions by the Federal Reserve and other major advanced-economy central banks.

In this study, we documented the deterioration in financial conditions of EMEs during the 2013 taper-tantrum episode. One intriguing aspect of this episode is that the response of EME financial markets was heterogeneous. Our study explored the role of country-specific characteristics, especially countries' macroeconomic fundamentals, in explaining the heterogeneous response. Looking at performance across the whole episode, our results indicate

[9] Of course, as some observers have noted, even in the well-known EME crises such as those in the 1990s, shocks outside of the EMEs themselves could sometimes act as one of the trigger points for the start of the crisis or for making it worse. Often these crises involved heightened country-specific domestic vulnerabilities, including over-borrowing in an environment of fixed exchange regimes, and, in this setting, external developments, such as a rise in global interest rates, contributed to their crises.

that there was differentiation by investors across EMEs explained in large part by variation in the strength of their economic fundamentals, and that the differentiation began early in the episode and persisted throughout it. This result holds whether we use different individual variables to measure economic fundamentals, or aggregate them to come up with a single index of relative vulnerabilities across EMEs. Taken at face value, these results suggest that policies to further strengthen economic fundamentals could go a long way to help the EMEs mitigate any disruptive effects from eventual normalization of monetary policy in the advanced economies.

While the strength of economic fundamentals was the most important factor influencing the deterioration of EME financial markets during the taper-tantrum episode, we find that other factors were at play as well. Controlling for economic fundamentals, financial market performance during the taper tantrum appeared to be weaker in those EMEs that had earlier received the largest gross private inflows of capital and had the greatest currency appreciations.

We further explored whether any heterogeneous responses of EME financial markets during past episodes of severe EME-wide financial stress over the past 20 years could also be explained by differences in economic fundamentals across EMEs. For the EME financial crises of the 1990s and early 2000s, we find little evidence that investors discriminated across EMEs significantly according to the strengths of their fundamentals. However, our results do suggest that differentiation among EMEs based on economic fundamentals has occurred since the mid-2000s, beginning with the global financial crisis in 2008 and progressively increasing over time through the European sovereign debt crisis of 2011, the 2013 taper-tantrum episode, and China's financial market stress in 2015.

The interpretation of the results that differentiation by investors across EMEs can be explained well by differences in economic fundamentals after the mid-2000s but not before is not clear-cut, however. One interpretation could be that, prior to the early 2000s, international investors differentiated less across EMEs due to a combination of still-developing policy frameworks, less heterogeneity, and less knowledge of differences across individual EMEs. As policy frameworks matured, as the EMEs became more integrated with world financial markets, and as advancement of technology facilitated timely and less costly access to information and data about particular EMEs, it became natural for investors to look more closely at differences in the EMEs' relative vulnerabilities. But another interpretation may lie in the idea that the factors

that have led to financial stresses in the EMEs have been different since the mid-2000s compared with the period before. In particular, there is a sense that the origins of the shocks causing periods of severe EME-wide financial stresses since the mid-2000s have been further removed from the EMEs themselves compared with the EME crises of the 1990s and early 2000s. The source of the shock may matter in how much investors differentiate across EMEs based on their economic fundamentals.

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Appendix

Table A1: Country names and symbols for the extended sample of 64 EMEs

Emerging Asia		Emerging Europe		Latin America		Middle East, North Africa, and Other	
Bangladesh	bj	Albania	ab	**Argentina***	**ar**	Algeria	ag
Bhutan	bp	Belarus	bf	**Bolivia***	**bo**	Armenia	ai
Cambodia	cb	Bosnia and Herzegovina	bm	**Brazil***	**bz**	Azerbaijan	aj
China*	**ch**	**Bulgaria***	**bg**	**Chile***	**cl**	Georgia	gg
Hong Kong	hk	**Croatia***	**cw**	**Colombia***	**co**	**Israel***	**is**
India*	**in**	**Czech Republic***	**cz**	**Costa Rica***	**cr**	Jordan	jr
Indonesia*	**id**	**Hungary***	**hu**	Dominican Rep.	dr	**Kazakhstan***	**kz**
Malaysia*	ma	**Latvia***	**lv**	El Salvador	es	Kuwait	ku
Mongolia	mo	**Lithuania***	**ln**	Guatemala	gt	Kyrgyz Republic	ky
Nepal	nl	Macedonia	mm	Honduras	ho	Lebanon	lb
Philippines*	**ph**	**Moldova***	**mv**	**Mexico***	**mx**	Morocco	mr
Singapore	si	**Poland***	**pl**	Nicaragua	nc	**Pakistan***	**pk**
South Korea*	**ko**	**Russia***	**ru**	**Paraguay***	**pg**	**Saudi Arabia***	**sa**
Sri Lanka	sl	**Serbia***	**sc**	**Peru***	**pe**	**South Africa***	**sf**
Taiwan*	**ta**	**Ukraine***	**ua**	**Uruguay***	**ug**	Tunisia	tn
Thailand*	**th**			Venezuela	ve	**Turkey***	**tk**
Vietnam	vt						

Note: Countries denoted with * superscript are included in the baseline sample of 35 EMEs. Among the EMEs in the baseline sample, the list of commodity exporters includes Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Indonesia, Kazakhstan, Malaysia, Paraguay, Peru, Russia, Saudi Arabia, South Africa, Ukraine, and Uruguay, as in World Bank (2017).

Table 1: Summary statistics for the 2013 taper-tantrum episode

Variable:	Obs	Mean	Median	St.Dev.	Min	Max	Source
Dependent variables:							
Exchange rate depreciation (%)	35	5.4	4.1	6.6	-2.0	22.8	IMF's IFS database
Depreciation pressure index	35	1.1	1.2	1.4	-0.6	4.2	Authors' calculations
Change in local currency bond yields (ppt)	24	0.9	0.6	0.8	-0.1	2.7	Bloomberg, IFS
Change in stock market index (%)	29	-0.8	-0.9	8.5	-15.0	15.8	Bloomberg
Change in EMBI spreads (ppt)	24	0.4	0.3	0.4	-0.3	1.1	JP Morgan's EMBI Global database
Change in CDS spreads (ppt)	29	0.3	0.4	0.3	-0.1	1.0	Markit
Memo:							
Change in reserves (%)	35	-2.4	-1.3	6.8	-24.9	12.5	IMF's IFS database
Macro fundamentals and policy variables:							
Current account/GDP 2012	35	-0.7	-1.6	5.9	-11.5	22.4	IMF's WEO database
Reserves/GDP 2012	35	26.5	22.4	18.3	4.6	89.4	Haver, IMF's IFS database
Short-term ext. debt/reserves 2012	35	43.6	41.3	24.4	2.7	109.6	Joint External Hub Database (BIS-IMF-OECD-WB)
Gov debt/GDP 2012	35	39.7	41.0	19.0	3.7	79.2	IMF's Historical Debt and WEO databases
Inflation, annual, 2010-12 average	35	4.8	3.9	2.5	1.4	11.6	Haver
Bank credit/GDP 5-year change, 2012	35	6.5	6.9	12.4	-24.4	29.9	IMF's IFS database
Vulnerability index 2012	35	20.0	19.8	6.3	4.8	32.2	Authors' calculations
Growth forecast 2013 revision, Consensus	33	0.0	-0.1	0.5	-0.7	2.2	Consensus growth forecast
Dummy, inflation targeter	33	0.6	1.0	0.5	0.0	1.0	IMF
Dummy, XR floater	33	0.6	1.0	0.5	0.0	1.0	IMF's AREAER
More-in-more-out variables:							
Gross inflows/GDP, cumul. 2010-12	32	2.3	2.1	2.4	-1.0	7.5	Haver
REER appreciation, average 2009-12	32	1.7	1.2	2.8	-2.7	8.3	Federal Reserve Board
Financial market structure:							
Market cap/GDP 2011	29	45.2	42.0	35.8	4.0	137.0	WB's WDI database
Foreign participation/market cap 2011	29	14.0	13.9	10.0	0.2	40.1	IMF's IFS database, WB's WDI database
Capital account openess 2011	29	0.4	0.0	1.4	-1.9	2.4	Chinn-Ito index database

Note: Changes in dependent variables are computed from April to August 2013. Exchange rates are expressed as units of local currency to the dollar, so that positive changes indicate depreciation. The depreciation pressure index is based on currency depreciation and losses in foreign exchange reserves, with larger values indicating stronger depreciation pressure. The "baseline" sample includes a maximum of 35 countries from Emerging Asia (China, India, Indonesia, South Korea, Malaysia, the Philippines, Taiwan, Thailand), Emerging Europe (Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Moldova, Poland, Russia, Serbia, Ukraine), Latin America (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Paraguay, Peru, Uruguay), and Other (Israel, Kazakhstan, Pakistan, Saudi Arabia, South Africa, and Turkey).

Table 2: Determinants of exchange rate depreciation and the depreciation pressure index

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
		Exchange rate depreciation, April-August 2013 (%)							Depreciation pressure index, April-August 2013						
Macro fundamentals and policy	CA/GDP 2012	0.10							0.066						
		(0.28)							(0.048)						
	Reserves/GDP 2012	-0.090							-0.028*						
		(0.092)							(0.016)						
	Short-term ext. debt/reserves 2012	-0.00096							0.0090						
		(0.049)							(0.0085)						
	Gov debt/GDP 2012	0.044							0.012						
		(0.059)							(0.010)						
	Inflation, average 2010-12	1.04**							0.30***						
		(0.46)							(0.080)						
	Bank credit/GDP 5-year change, 2012	0.17*							0.030*						
		(0.087)							(0.015)						
	Vulnerability index 2012		0.56***	0.57***	0.46**	0.56***	0.59***			0.14***	0.14***	0.13***	0.15***	0.14***	
			(0.16)	(0.18)	(0.17)	(0.14)	(0.16)			(0.029)	(0.037)	(0.033)	(0.030)	(0.033)	
	Growth forecast 2013 revision			3.04							0.45				
				(1.95)							(0.41)				
	Dummy, inflation targeter			-3.82							-0.39				
				(3.17)							(0.66)				
	Dummy, XR floater			5.30*							0.42				
				(3.09)							(0.65)				
More-in-more-out	Gross inflows/GDP, cumul. 2010-12				0.81*							0.11			
					(0.44)							(0.087)			
	REER appreciation, average 2009-12					1.00***							0.097		
						(0.32)							(0.067)		
Financial structure	Market cap/GDP, 2011						0.080**							0.0067	
							(0.030)							(0.0060)	
	Foreign participation/market cap, 2011						0.020							0.015	
							(0.097)							(0.020)	
	Capital account openess						-0.74							-0.33**	
							(0.79)							(0.16)	
Principal component analysis	1st principal component							-1.39*							-0.43***
								(0.76)							(0.15)
	2nd principal component							2.51*							0.49*
								(1.39)							(0.27)
	3rd principal component							-0.51							0.057
								(1.03)							(0.20)
	Constant	0.096	-5.82*	-6.42*	-5.36	-6.97**	-9.91**	5.09***	-0.58	-1.76***	-1.74**	-1.82**	-1.96***	-1.89**	1.08***
		(4.82)	(3.26)	(3.33)	(3.42)	(2.99)	(4.15)	(1.06)	(0.83)	(0.62)	(0.70)	(0.67)	(0.62)	(0.84)	(0.21)
	Observations	35	35	33	32	32	29	35	35	35	33	32	32	29	35
	R-squared	0.34	0.28	0.43	0.35	0.49	0.55	0.26	0.55	0.42	0.44	0.45	0.50	0.62	0.36

Note: Exchange rates are in units of local currency to the dollar, so that positive changes indicate depreciation. The depreciation pressure index is based on currency depreciation and losses in foreign exchange reserves, with larger values indicating stronger depreciation pressure. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Determinants of the increase in bond yields and the decline in stock market prices

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
		Increase in bond yields, April-August 2013 (ppt)							Stock market price increase, April-August 2013 (%)						
Macro fundamentals and policy	CA/GDP 2012	0.0058							-0.32						
		(0.045)							(0.57)						
	Reserves/GDP 2012	-0.029**							0.21						
		(0.012)							(0.18)						
	Short-term ext. debt/reserves 2012	0.0084							0.0017						
		(0.0056)							(0.027)						
	Gov debt/GDP 2012	-0.0060							0.047						
		(0.0078)							(0.082)						
	Inflation, average 2010-12	0.0082							0.11						
		(0.075)							(0.78)						
	Bank credit/GDP 5-year change, 2012	0.033***							-0.39***						
		(0.011)							(0.13)						
	Vulnerability index 2012		0.099***	0.11***	0.099***	0.10***	0.11***			-0.30	-0.29	-0.27	-0.33	-0.41	
			(0.020)	(0.019)	(0.028)	(0.018)	(0.029)			(0.26)	(0.31)	(0.35)	(0.25)	(0.35)	
	Growth forecast 2013 revision			-0.080							-3.62				
				(0.25)							(4.62)				
	Dummy, inflation targeter			1.44***							-8.97*				
				(0.33)							(5.14)				
	Dummy, XR floater			-1.32***							3.57				
				(0.34)							(5.58)				
More-in-more-out	Gross inflows/GDP, cumul. 2010-12				0.014							-0.28			
					(0.061)							(0.87)			
	REER appreciation, average 2009-12					0.11**							-1.36**		
						(0.040)							(0.61)		
Financial structure	Market cap/GDP, 2011						0.0044							-0.060	
							(0.0052)							(0.059)	
	Foreign participation/market cap, 2011						-0.020							-0.025	
							(0.018)							(0.21)	
	Capital account openess						0.093							-0.99	
							(0.15)							(1.70)	
Principal component analysis	1st principal component							-0.38***							0.58
								(0.11)							(0.97)
	2nd principal component							-0.085							-1.02
								(0.18)							(1.28)
	3rd principal component							-0.52***							4.15**
								(0.17)							(1.51)
	Constant	1.25*	-1.07**	-1.47***	-1.11**	-1.24***	-1.10	0.93***	-6.41	4.95	7.09	5.03	7.36	10.6	-0.90
		(0.63)	(0.42)	(0.36)	(0.51)	(0.39)	(0.76)	(0.13)	(7.61)	(5.27)	(5.69)	(6.38)	(5.34)	(8.76)	(1.43)
	Observations	24	24	22	22	23	21	24	29	29	27	25	26	25	29
	R-squared	0.59	0.52	0.77	0.51	0.65	0.55	0.51	0.34	0.05	0.24	0.06	0.22	0.09	0.28

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Determinants of the increase in EMBI spreads and CDS spreads

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
		Increase in EMBI spreads, April-August 2013 (ppt)							Increase in CDS spreads, April-August 2013 (ppt)						
Macro fundamentals and policy	CA/GDP 2012	-0.032							-0.0013						
		(0.021)							(0.013)						
	Reserves/GDP 2012	-0.014*							-0.0062						
		(0.0077)							(0.0038)						
	Short-term ext. debt/reserves 2012	-0.0020							-0.0013						
		(0.0031)							(0.00074)						
	Gov debt/GDP 2012	0.0019							-0.0027						
		(0.0040)							(0.0023)						
	Inflation, average 2010-12	0.038							0.067***						
		(0.036)							(0.023)						
	Bank credit/GDP 5-year change, 2012	-0.00084							0.0054						
		(0.0058)							(0.0033)						
	Vulnerability index 2012		0.041***	0.042***	0.038***	0.040***	0.042***			0.026***	0.026***	0.021**	0.026***	0.028***	
			(0.011)	(0.014)	(0.010)	(0.012)	(0.013)			(0.0077)	(0.0088)	(0.0077)	(0.0080)	(0.0084)	
	Growth forecast 2013 revision			-0.084							0.067				
				(0.13)							(0.14)				
	Dummy, inflation targeter			-0.072							0.23				
				(0.19)							(0.15)				
	Dummy, XR floater			0.060							-0.33**				
				(0.19)							(0.14)				
More-in-more-out	Gross inflows/GDP, cumul. 2010-12				0.025							0.035*			
					(0.024)							(0.019)			
	REER appreciation, average 2009-12					0.028							0.034*		
						(0.024)							(0.017)		
Financial structure	Market cap/GDP, 2011						0.0022							0.00068	
							(0.0022)							(0.0016)	
	Foreign participation/market cap, 2011						-0.0024							-0.0067	
							(0.0074)							(0.0047)	
	Capital account openess						-0.075							-0.070	
							(0.065)							(0.044)	
Principal component analysis	1st principal component							-0.28***							-0.083**
								(0.071)							(0.033)
	2nd principal component							-0.0057							0.057
								(0.082)							(0.042)
	3rd principal component							-0.045							-0.045
								(0.068)							(0.052)
	Constant	0.51	-0.49*	-0.49*	-0.46**	-0.53*	-0.54	0.35***	0.37**	-0.18	-0.11	-0.13	-0.23	-0.076	0.35***
		(0.31)	(0.24)	(0.26)	(0.22)	(0.26)	(0.31)	(0.063)	(0.18)	(0.15)	(0.15)	(0.15)	(0.15)	(0.22)	(0.048)
	Observations	24	24	24	23	22	21	24	29	29	28	25	25	23	29
	R-squared	0.52	0.39	0.41	0.47	0.41	0.52	0.47	0.56	0.31	0.43	0.44	0.48	0.54	0.28

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Examination of the April-August 2013 event: the depreciation pressure index

(a) Cumulative stress

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Depreciation pressure index	Apr-May	Apr-Jun	Apr-Jul	Apr-Aug	Apr-Sep	Apr-Oct	Apr-Nov	Apr-Dec
Vulnerability index (2012)	0.094***	0.11***	0.13***	0.14***	0.14***	0.14***	0.13***	0.13***
	(0.034)	(0.026)	(0.029)	(0.029)	(0.032)	(0.035)	(0.038)	(0.040)
Observations	35	35	35	35	35	35	35	35
R-squared	0.19	0.36	0.36	0.42	0.37	0.32	0.28	0.24

(b) Incremental stress

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Depreciation pressure index	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec
Vulnerability index (2012)	0.094***	0.079***	0.056	0.10***	0.016	-0.0065	0.066*	-0.015
	(0.034)	(0.027)	(0.036)	(0.023)	(0.041)	(0.047)	(0.033)	(0.044)
Observations	35	35	35	35	35	35	35	35
R-squared	0.19	0.21	0.07	0.38	0.01	0.00	0.11	0.00

Note: The dependent variable is the depreciation pressure index for each interval, with larger values indicating stronger depreciation pressure. The regression sample for depreciation pressure index consists of the baseline sample of 35 countries listed under Table 1. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6: Examination of the April-August 2013 event: the increase in bond yields

(a) Cumulative stress

Dependent variable: Change in bond yields	(1) Apr-May	(2) Apr-Jun	(3) Apr-Jul	(4) Apr-Aug	(5) Apr-Sep	(6) Apr-Oct	(7) Apr-Nov	(8) Apr-Dec
Vulnerability index (2012)	-0.0059	0.042**	0.079***	0.099***	0.10***	0.081***	0.10***	0.12***
	(0.0063)	(0.019)	(0.022)	(0.020)	(0.020)	(0.019)	(0.024)	(0.028)
Observations	24	24	24	24	24	24	24	24
R-squared	0.04	0.19	0.37	0.52	0.53	0.46	0.47	0.45

(b) Incremental stress

Dependent variable: Change in bond yields	(1) Apr-May	(2) May-Jun	(3) Jun-Jul	(4) Jul-Aug	(5) Aug-Sep	(6) Sep-Oct	(7) Oct-Nov	(8) Nov-Dec
Vulnerability index (2012)	-0.0059	0.047***	0.038***	0.019***	0.0025	-0.020*	0.023**	0.015**
	(0.0063)	(0.015)	(0.010)	(0.0066)	(0.0078)	(0.011)	(0.0085)	(0.0070)
Observations	24	24	24	24	24	24	24	24
R-squared	0.04	0.30	0.37	0.29	0.01	0.14	0.24	0.18

Note: Due to data availability, the regression sample for government bond yields includes 24 countries from Emerging Asia (China, India, Indonesia, South Korea, Malaysia, the Philippines, Taiwan, Thailand), Emerging Europe (Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Moldova, Poland, Russia, Ukraine), Latin America (Brazil, Colombia, Mexico), and Other (Israel, South Africa, Turkey). Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Differentiation across EMEs during past events

(a) Dependent variable: depreciation pressure index

	(1) Mexican crisis	(2) Asian crisis	(3) Russian crisis	(4) Argentine crisis	(5) GFC	(6) Euro crisis	(7) Taper tantrum	(8) China's fin. stress
Vulnerability index (y-1)	-0.026	0.034	0.069	0.048	0.098***	0.11***	0.14***	0.062**
	(0.015)	(0.048)	(0.063)	(0.037)	(0.031)	(0.033)	(0.029)	(0.025)
Observations	23	28	33	37	35	35	35	30
R-squared	0.12	0.02	0.04	0.04	0.23	0.27	0.42	0.18
Excludes	MX	ID KO MA PH TH	RU	AR UG	RU			CH

(b) Dependent variable: change in bond yields (ppt)

	(1) Mexican crisis	(2) Asian crisis	(3) Russian crisis	(4) Argentine crisis	(5) GFC	(6) Euro crisis	(7) Taper tantrum	(8) China's fin. stress
Vulnerability index (y-1)				0.065	0.17*	0.048	0.099***	0.072***
				(0.054)	(0.084)	(0.029)	(0.020)	(0.020)
Observations				15	21	24	24	21
R-squared				0.10	0.18	0.11	0.52	0.40
Excludes				AR UG	RU			CH

(c) Dependent variable: depreciation pressure index, pooled sample of episodes

	(1) Before GFC	(2) During and after GFC	(3) Before GFC	(4) During and after GFC	(5) Before GFC	(6) During and after GFC
Vulnerability index (y-1)	-0.033	0.131***	0.021	0.116***	0.029	0.105***
	(0.040)	(0.037)	(0.025)	(0.016)	(0.023)	(0.015)
Observations	121	135	121	135	121	135
Events	4	4	4	4	4	4
R-squared	0.48	0.53	0.21	0.34	0.20	0.32
Fixed effects	Country, event	Country, event	Region, event	Region, event	Commodity exporter, event	Commodity exporter, event

Note: In panel (c), the regressions used pooled samples of countries and events. "Before GFC" pools the sample for the Mexican, Asian, Russian, and Argentine crises. "During and after GFC" pools the sample for the GFC, Euro crisis, taper tantrum, and China's financial market stress. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Differentiation across EMEs during past events

(a) Panel regressions with pooled sample of episodes and countries: fixed effects and slopes for regions

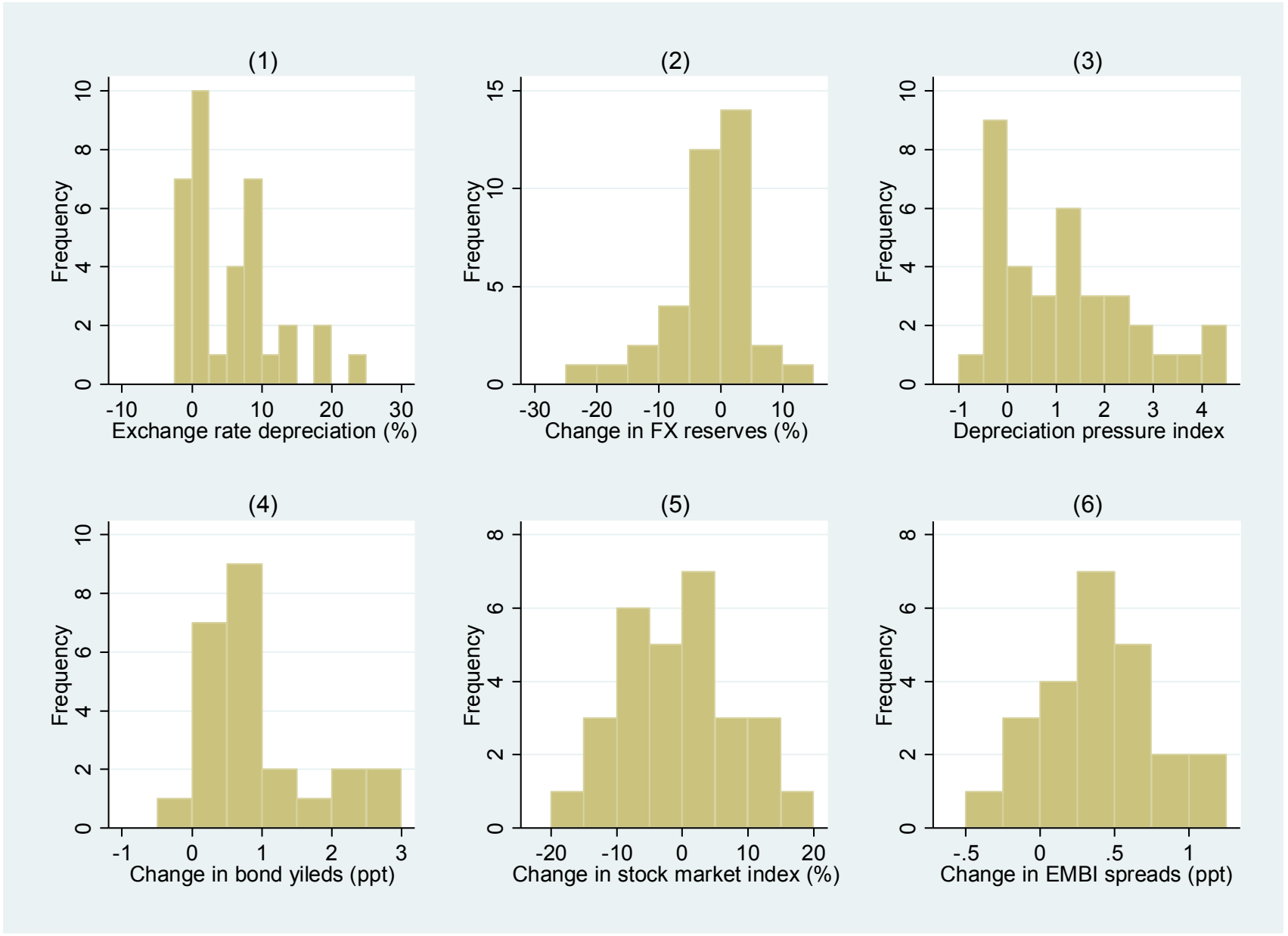
Dependent variable:	(1)	(2)	(3)	(4)
Depreciation pressure index	Before GFC	During and after GFC	Before GFC	During and after GFC
Vulnerability index (y-1)	0.021	0.116***		
	(0.025)	(0.016)		
Vulnerability index (y-1) * EMAS			-0.065	0.140***
			(0.049)	(0.033)
Vulnerability index (y-1) * LATAM			0.055	0.102**
			(0.048)	(0.040)
Vulnerability index (y-1) * EMEU			0.075	0.113***
			(0.048)	(0.037)
Vulnerability index (y-1) * Other			0.028	0.110***
			(0.060)	(0.026)
Observations	121	135	121	135
Events	4	4	4	4
R-squared	0.206	0.342	0.238	0.345
Fixed effects	Region, episode	Region, episode	Region, episode	Region, episode

(b) Panel regressions with pooled sample of episodes and countries: fixed effects and slopes for commodity exporter

Dependent variable:	(1)	(2)	(3)	(4)
Depreciation pressure index	Before GFC	During and after GFC	Before GFC	During and after GFC
Vulnerability index (y-1)	0.029	0.105***		
	(0.023)	(0.015)		
Vuln. index (y-1) * Non-Comm. Exp.			0.022	0.119***
			(0.030)	(0.021)
Vuln. index (y-1) * Comm. Exporter			0.037	0.090***
			(0.036)	(0.022)
Observations	121	135	121	135
Events	4	4	4	4
R-squared	0.198	0.316	0.199	0.321
Fixed effects	Commodity exporter, episode	Commodity exporter, episode	Commodity exporter, episode	Commodity exporter, episode

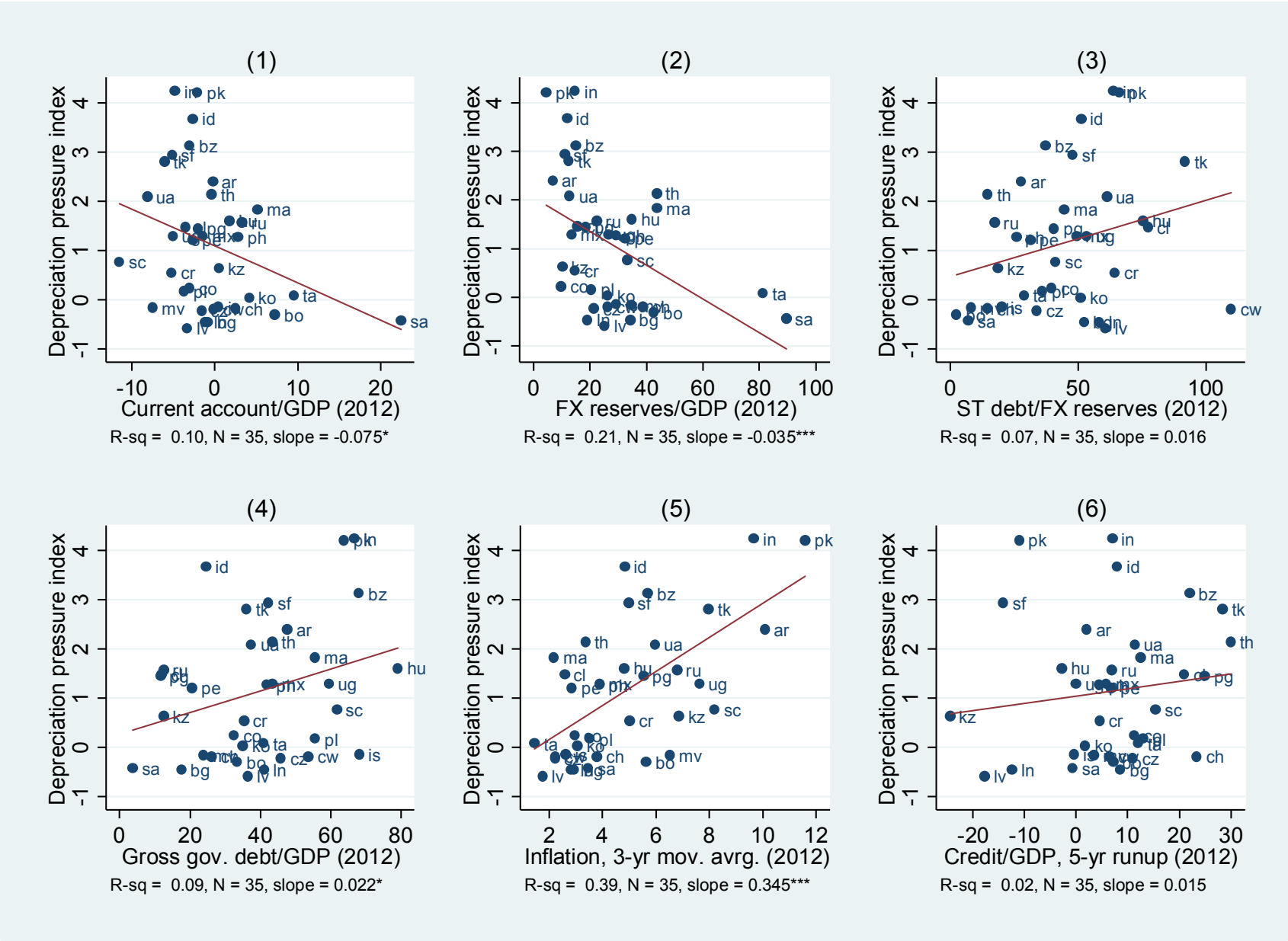
Note: Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Financial performance during April-August 2013



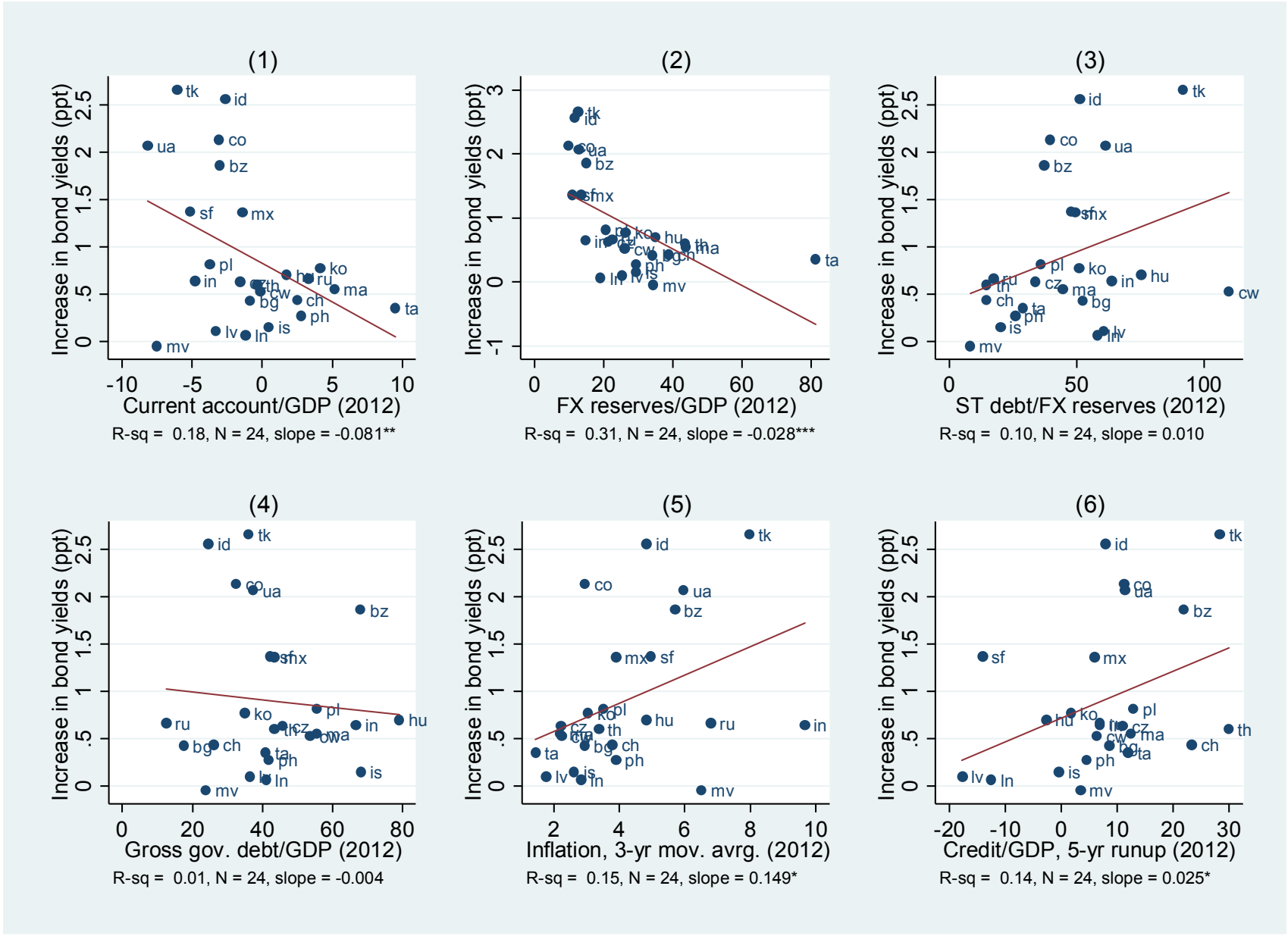
Note: Exchange rates are expressed in units of local currency to the dollar, with positive changes indicating depreciation. The depreciation pressure index is based on currency depreciation and losses in foreign exchange reserves, with larger values indicating stronger depreciation pressure.

Figure 2: Depreciation pressure and macroeconomic fundamentals during April-August 2013



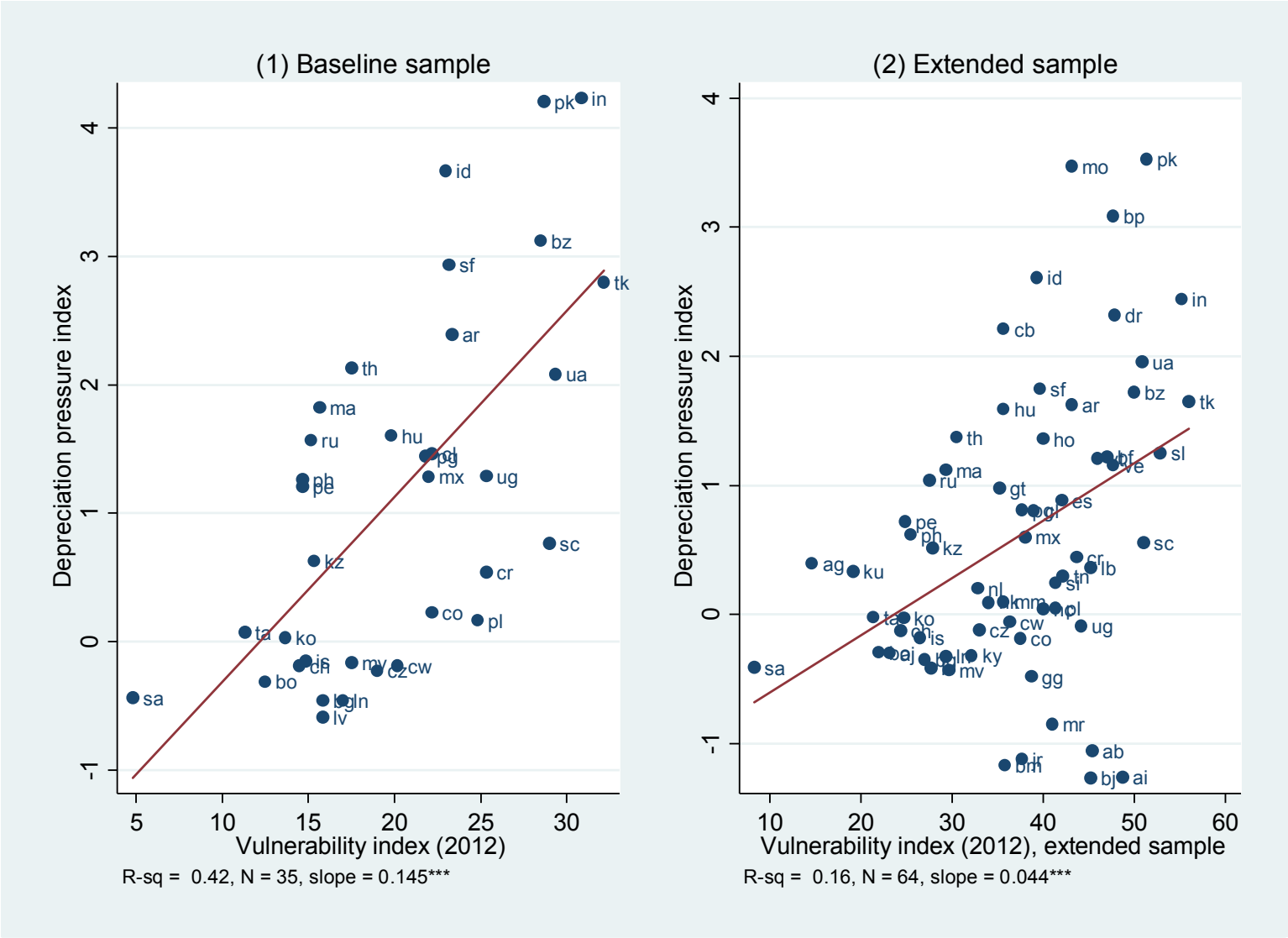
Note: In each panel, the vertical axis shows the depreciation pressure index, with larger values indicating stronger depreciation pressure. Star superscripts indicate *** p<0.01, ** p<0.05, * p<0.1. For the list of country codes used in scatterplots, see Table A1 in the Appendix.

Figure 3: Increase in local currency government bond yields and macroeconomic fundamentals during April-August 2013



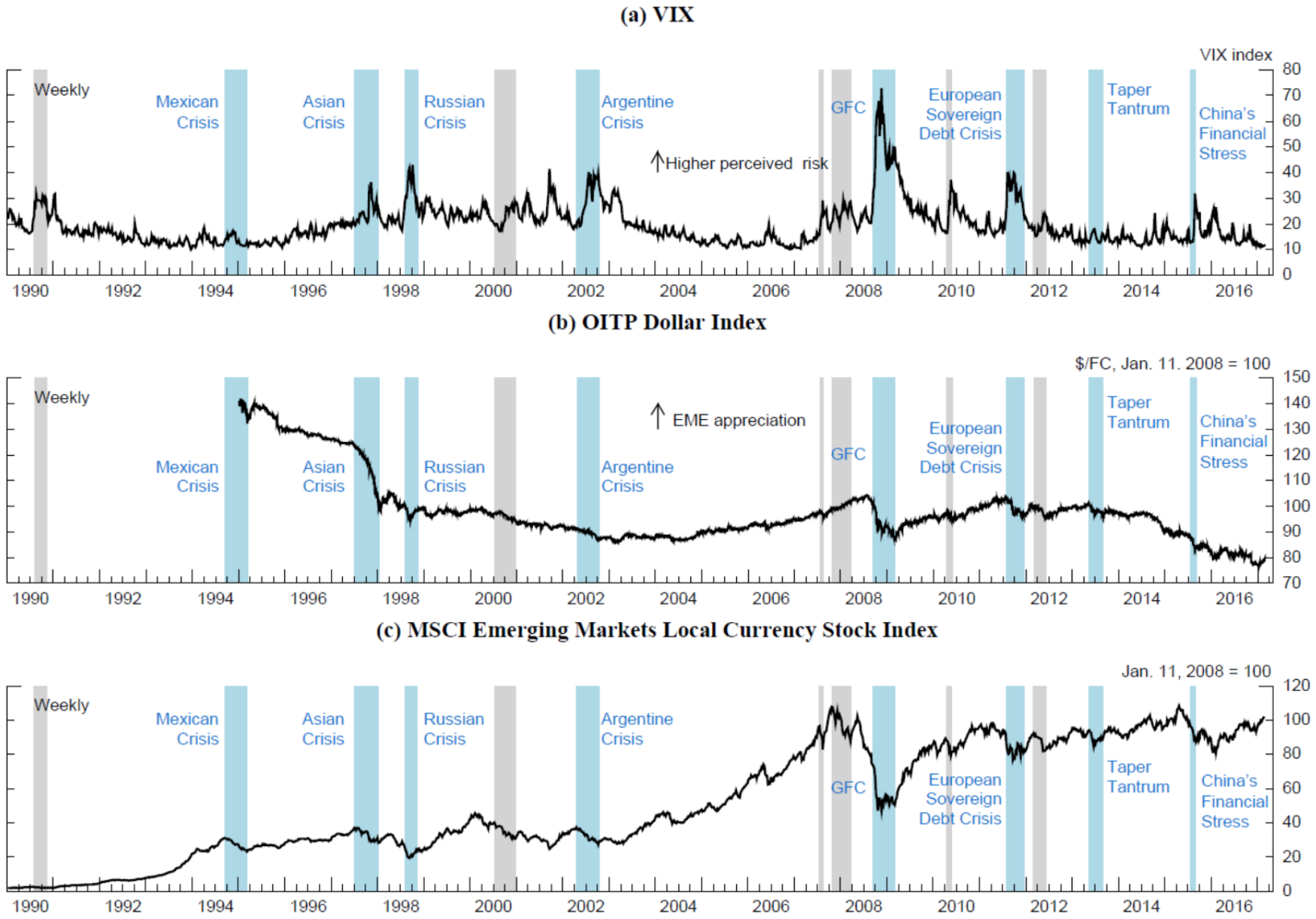
Note: Star superscripts indicate *** p<0.01, ** p<0.05, * p<0.1.

Figure 4: Depreciation pressure and macroeconomic fundamentals during April-August 2013



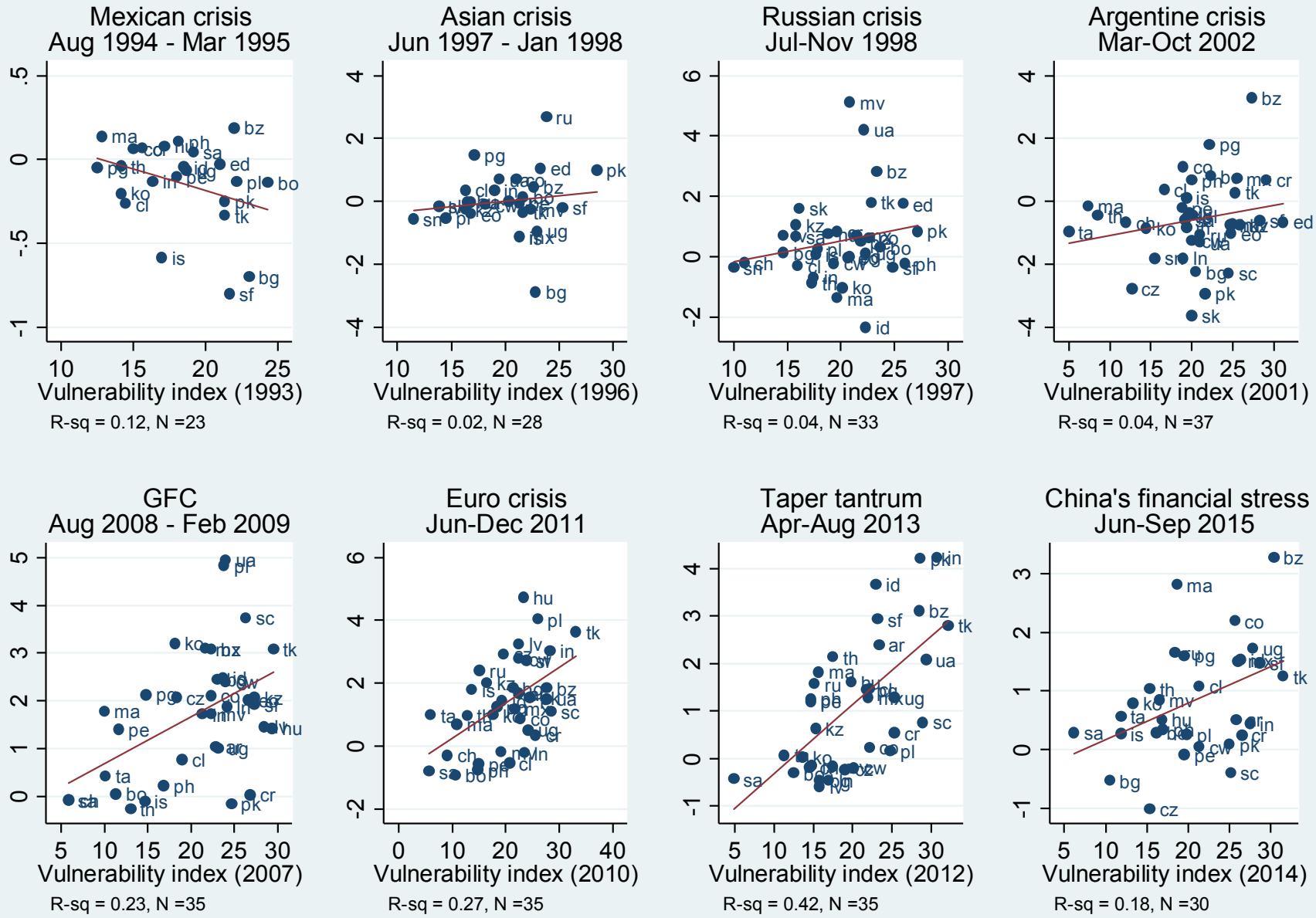
Note: The depreciation pressure index is based on currency depreciation and losses in foreign exchange reserves, with larger values indicating stronger depreciation pressure. In panel (1), the baseline sample consists of the 35 countries described under Tables 1 and 5. In panel (2), the "extended sample" consists of the baseline sample plus 29 economies from Emerging Asia (Bangladesh, Bhutan, Cambodia, Hong Kong, Mongolia, Nepal, Singapore, Sri Lanka, Vietnam), Emerging Europe (Albania, Belarus, Bosnia and Herzegovina, Macedonia), Latin America (Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Venezuela), and the Middle East, North Africa, and Other (Algeria, Armenia, Azerbaijan, Georgia, Jordan, Kuwait, Kyrgyz Republic, Lebanon, Morocco, Tunisia).

Figure 5: Identification of past events of financial stress



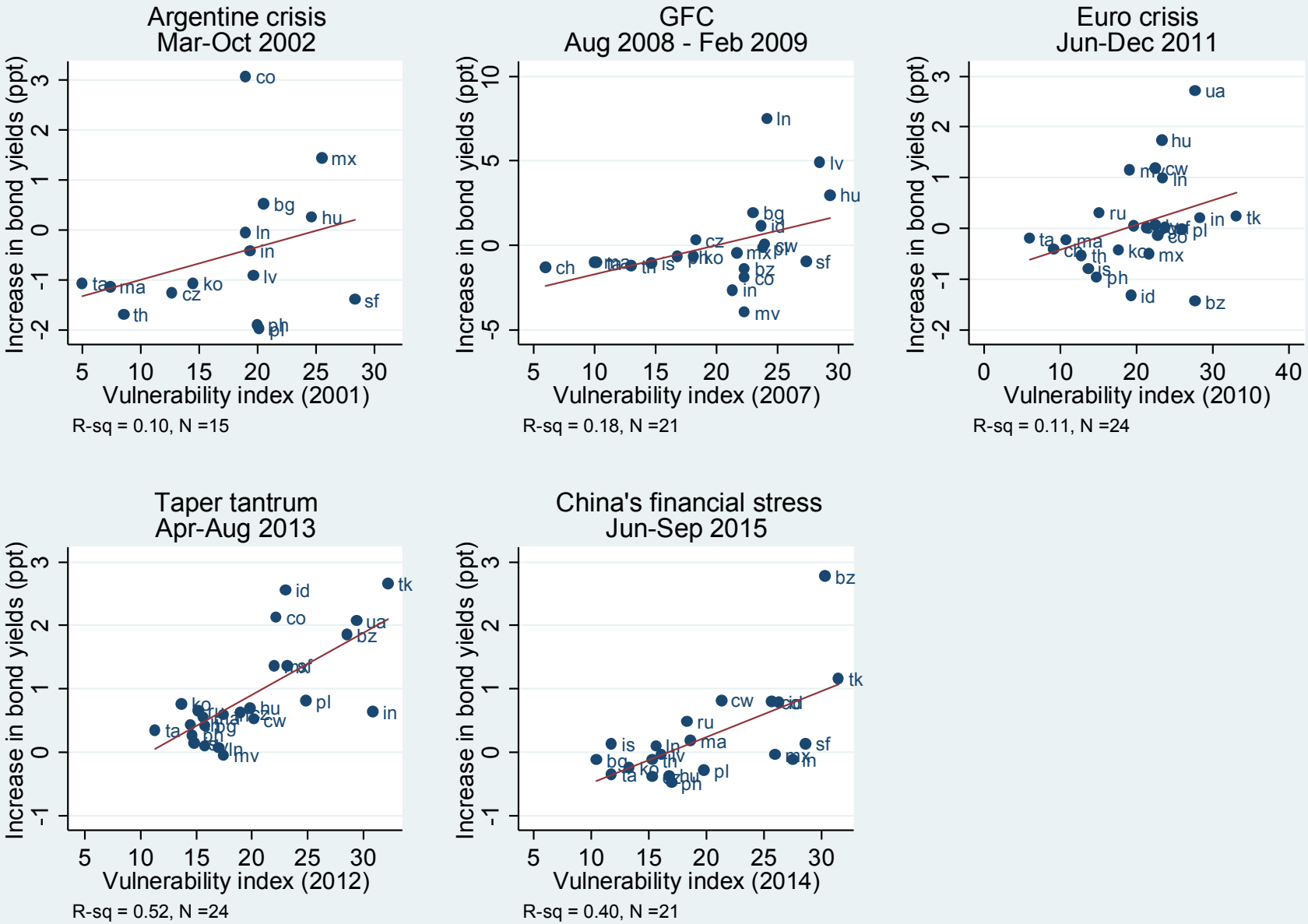
Note: The start and end dates for each of the 13 events in chronological order are as follows: (1) August 3 to November 9, 1990; (2) September 16, 1994 to March 10, 1995; (3) July 4 to August 29, 1997 and October 31, 1997 to January 9, 1998, merged in one single event; (4) August 14 to November 6, 1998; (5) July 14 to December 22, 2000; (6) April 19 to October 11, 2002; (7) July 20 to August 17, 2007; (8) October 26, 2007 to March 21, 2008; (9) September 19, 2008 to February 27, 2009; (10) April 9 to May 21, 2010; (11) July 29 to December 16, 2011; (12) March 2 to June 1, 2012; (13) May 10 to August 30, 2013; (14) July 17 to September 4, 2015.

Figure 6: Depreciation pressure and macroeconomic fundamentals during past events of financial stress



Note: For each event, the vertical axis shows the depreciation pressure index, with larger values indicating stronger depreciation pressure.

Figure 7: Change in bond yields and macroeconomic fundamentals during past events of financial stress



Note: For each event, the vertical axis shows the change in bond yields expressed in percentage points.