

Online Annex 2.1. Additional Details on Empirical Analysis

Data Sources

The chapter studies episodes of external stress for a group of 73 advanced and emerging market and developing economies (see Annex Table 2.1.1). Given data constraints, especially regarding the foreign currency composition of external debt, the period considered is 1991–2018.

Annex Table 2.1.1. List of Economies

Economies	Economies
Argentina	Kazakhstan
Australia	Korea
Austria	Latvia
Bangladesh	Lithuania
Belarus	Malaysia
Belgium	Mexico
Bosnia and Herzegovina	Morocco
Brazil	Netherlands
Canada	New Zealand
Chile	Nigeria
China	North Macedonia
Colombia	Norway
Croatia	Oman
Czech Republic	Pakistan
Denmark	Peru
Dominican Republic	Philippines
Egypt	Poland
El Salvador	Portugal
Estonia	Romania
Finland	Russia
France	Singapore
Georgia	Slovak Republic
Germany	Slovenia
Greece	South Africa
Guatemala	Spain
Hong Kong SAR	Sri Lanka
Hungary	Sweden
Iceland	Switzerland
India	Thailand
Indonesia	Tunisia
Ireland	Turkey
Israel	Ukraine
Italy	United Kingdom
Jamaica	United States
Japan	Uruguay
Jordan	Venezuela
	Vietnam

Annex Table 2.1.2 lists the source of the variables used in the analysis. The underlying data for the international investment position (IIP, including foreign official reserves), current account, and nominal GDP are taken from the updated version of the External Wealth of Nations database (EWN, Lane and Milesi-Ferretti 2007); the foreign currency shares of external debt are based on Bénétrix and others (2019). For countries not available in this database, foreign currency exposure is taken from Bénétrix, Lane, and Shambaugh (2015), assuming constant weights to extend the sample to 2017. “Net” is defined as asset minus liability positions, “equity” refers to the sum of foreign direct investment (FDI) equity and portfolio equity, and “debt” (either assets or liabilities) represents the sum of portfolio debt securities, other investment, and FDI debt. Since the EWN database does not break down debt and equity FDI, data from the IMF’s *International Financial Statistics* (where available) are used to estimate this breakdown.

Annex Table 2.1.2. Data Sources

Indicator	Source
International Investment Position and its Components	External Wealth of Nations database (Lane and Milesi-Ferretti, 2007)
Current account	External Wealth of Nations database (Lane and Milesi-Ferretti, 2007)
Nominal GDP	External Wealth of Nations database (Lane and Milesi-Ferretti, 2007)
Foreign currency share of external liabilities	Bénétrix and others (2019), Bénétrix, Lane, and Shambaugh (2015)
Private external debt defaults/restructurings	Asonuma and Trebesch (2016)
Official external debt restructurings	Das, Papaioannou, and Trebesch (2011), Paris Club (http://www.clubdeparis.org/en/traitements)
Real effective exchange rate (2010=100)	IMF, Information Notice Systems
Income per capita	IMF World Economic Outlook
Fiscal balance	IMF WEO and national sources
Credit	Bank for International Settlements, World Development Indicators
Financial development index	Svirydzenka (2016)
VXO	Haver Analytics

An external stress episode is an episode of sovereign debt default or restructuring or an IMF arrangement. External debt defaults and restructuring episodes with private creditors are taken from Asonuma and Trebesch (2016), while official external debt restructurings are based on Paris Club reports (<http://www.clubdeparis.org/en/traitements> and Das, Papaioannou, and Trebesch 2011). A total of 128 cases of external stress episodes are identified, most of which involve emerging market and developing economies. This includes 111 IMF arrangements, 6 defaults with private creditors and 35 sovereign debt restructurings (some episodes overlap).

Event Study Analysis

The evolution of the IIP and its key components are tracked around episodes of external stress to help gauge what levels of exposure are riskier relative to each country’s historical mean. In line with the analysis in Gourinchas and Obstfeld (2012) and Catão and Milesi-Ferretti (2014), the following specification is used to perform a standard unconditional event analysis:

$$y_{it} = \alpha_i + \delta_t + \sum_{s=-5}^5 \beta_s D_{t+s} + \varepsilon_{it} ,$$

in which α_i and δ_t are country and time fixed effects, respectively capturing country-specific and global developments, D_{t+s} are dummy variables (11 in total) taking a value of 1 at year t (when the event occurs), and y_{it} is the IIP component being considered. The coefficients β_s , which are

plotted in Figure 2.3, thus capture how much the movement of the variable is associated with the external stress episode.

Probit Estimates: Results and Robustness

Estimation Results

A pooled probit model is used to study the likelihood of external stress episodes. The setup is similar to Catão and Milesi-Ferretti (2014). The independent variables can be placed in three groups: (1) IIP components for each country, (2) macroeconomic variables for each country, such as the current account balance, the real exchange rate gap (measured as deviations of the real exchange rate from the average of the previous five years), the credit gap (also measured as deviations from the credit-to-GDP ratio from the average of the previous five years), the level of financial development and income per capita relative to the United States (including in the form of an interaction term), and (3) a global risk variable (captured by the VXO, an indicator similar to the Chicago Board Options Exchange Volatility Index [VIX] but with longer time series). The first two categories are lagged by one year to control for endogeneity.

Robustness

The main findings are robust to alternative specifications of the probit baseline regression, which involves (1) changes in country sample (to exclude oil exporters), (2) changes in the definition of stress episodes (to exclude consecutive years; different types of IMF arrangements; and to include Spain's European Stability Mechanism program), (3) inclusion of additional controls (to consider the exchange rate regime, capital account openness, and terms-of-trade changes), (4) alternative estimation techniques (logit model), and (5) winsorizing all the independent variables to account for outliers (1 percent from both tails). The results are also robust when only large crises (same as the baseline definition, but with IMF loans greater than 200 percent of quota) are considered (Catão and Milesi-Ferretti, 2014). In addition, the results are robust to excluding large financial centers such as Iceland and Ireland from the sample. In fact, the exclusion of Iceland makes the coefficients for foreign-currency-denominated debt liabilities stronger than that of the entire sample. All these results are generally robust both for the full sample as well as the emerging markets and developing economies sample.

The baseline regressions do not address what is referred to as “potential postcrisis” bias in the literature (Bussiere and Fratzscher 2006) related to the distinction between tranquil periods (economic fundamentals are sound and sustainable) and stress/poststress periods (economic variables go through an adjustment process before reaching a sustainable level). To address these concerns, many studies have adopted various methodologies for approximations, each with important advantages and disadvantages. When incorporating these considerations using various methodologies, the results remain robust and often point toward highly statistically significant coefficients. In only one case do the estimations show significant but weaker results.¹

¹ The robustness tests related to market access considerations are addressed in the following manner. First, regressions are run for periods of market access, with the data for market access until 2010 taken from Asonuma and Trebesch (2016) for 50 countries, including 40 emerging

(continued)

Measuring the Stress Episode Impact on Output, Current Account, and Exchange Rate Effects, Depending on Preexisting Vulnerabilities: The Local Projection Method

The dynamic responses of output (and the real effective exchange rate [REER] and the current-account-to-GDP ratio) to external stress events are estimated using local projection methods (LPM, Jordà 2005) using the following specification:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta^H D_{i,t}^H \text{Stress}_{i,t} + \beta^O (1 - D_{i,t}^H) \text{Stress}_{i,t} + \nu X_{i,t} + \varepsilon_{i,t}$$

in which

- $y_{i,t+k}$ is either the natural logarithm of output, the natural logarithm of the REER, or the current-account-to-GDP ratio of country i at time $t+k$,
- α_i and γ_t are country and time fixed effects,
- $D_{i,t}^H$ is a dummy variable = 1 for countries with high foreign currency debt (above sample median), a high current account deficit (below sample median for current account balance), and low foreign currency reserves (below sample median) and 0 for the rest of the sample,
- $\text{Stress}_{i,t}$ is a dummy variable = 1 for stress episode in country i at time t , and 0 for no stress,
- $X_{i,t}$ contains additional regressors: two-year lags of change in output, REER, and current account, for country i at time t ,
- $\varepsilon_{i,t}$ is an unexplained residual.

market and developing economies. The results are robust to these considerations. Second, Gourinchas and Obstfeld (2012) remove data for four years after a stress event. However, the number of years for market access, following an external event, can vary considerably across countries and has declined in recent years with data availability (Asonuma and Trebesch 2016). Since our sample starts in 1990 (later than in other studies) and, hence, data of more recent years are more relevant, the robustness tests are performed removing one, two, three, and four years after the stress event. The results are robust (and often stronger) for the entire sample and for the emerging market and developing economy sample in all cases. A few exceptions occur when three and four years are removed for emerging market and developing economies, and when four years are removed for the full sample: the results are robust in a specification with fewer control variables, but the coefficient for foreign-currency-denominated debt liabilities is smaller in the case of emerging markets and developing economies. Third, estimations are run by removing stress episode consecutive years. The results are robust to this specification.

References

- Asonuma, Tamon, and Christoph Trebesch. 2016. “Sovereign Debt Restructurings: Preemptive or Post-Default.” *Journal of the European Economic Association* 14: 175–214.
- Bénétrix, Agustín, Deepali Gautam, Luciana Juvenal, and Martin Schmitz. 2019. “Cross-Border Currency Exposures.” IMF Working Paper 19/299, International Monetary Fund, Washington, DC.
- Bénétrix, Agustín, Philip R. Lane, and Jay C. Shambaugh. 2015. “International Currency Exposures, Valuation Effects, and the Global Financial Crisis.” *Journal of International Economics* 96 (S1): 98–109.
- Bussiere, Matthieu, and Marcel Fratzscher. 2006. “Towards a New Early Warning System of Financial Crises.” *Journal of International Money and Finance* 25: 953–73.
- Das, Udaibir S., Michael G. Papaioannou, and Christoph Trebesch. 2011. “Sovereign Debt Restructurings 1950–2010: Literature Survey, Data, and Stylized Facts.” IMF Working Paper 12/203, International Monetary Fund, Washington, DC.
- Gourinchas, Pierre-Olivier, and Maurice Obstfeld. 2012. “Stories of the Twentieth Century for the Twenty-First.” *American Economic Journal: Macroeconomics* 4(1): 226–265.
- Lane, Philip R., and Gian Maria Milesi-Ferretti. 2007. “The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004.” *Journal of International Economics* 73 (2): 223–50.
- Svirydzenka, Katsiaryna. 2016. “Introducing a New Broad-Based Index of Financial Development.” IMF Working Paper 16/5, International Monetary Fund, Washington, DC.