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CHAPTER 2

EXTERNAL STRESS AND THE INTERNATIONAL INVESTMENT POSITION

Table of Contents

CHAPTER 2

EXTERNAL STRESS AND THE INTERNATIONAL INVESTMENT POSITION

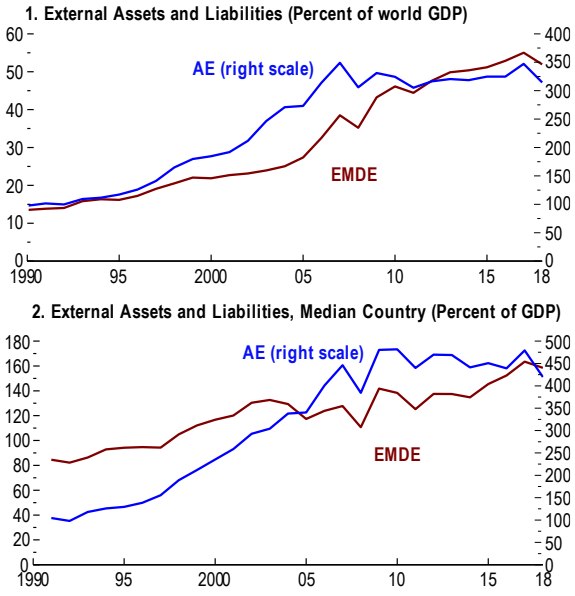
Countries' external assets and liabilities reached historic highs in the years before the Great Lockdown. This chapter examines the relationship between the structure of external assets and liabilities—the components of the international investment position (IIP)—and the risk of external stress events, defined as episodes featuring an external debt default, debt restructuring, or access to IMF support. For a sample of 73 economies over the past three decades, it finds that some components of the IIP relate more strongly to external stress than others do, suggesting that a disaggregated approach can usefully complement the information content of the net IIP for assessing risks. Debt liabilities in foreign currency increase the likelihood of an external stress episode, especially for emerging market and developing economies, while official foreign exchange reserves play a mitigating role. Additional well-studied factors, such as large current account deficits, also come with higher risks. Heightened global risk aversion, as during the Great Lockdown, amplifies these risks. When an external stress episode occurs, countries with greater preexisting external vulnerabilities typically experience larger output losses and sharper current account adjustments. Creditor countries, on average, experience substantial valuation losses during periods of global financial stress, highlighting the risks and costs of excessive external imbalances for both debtor and creditor countries.

Introduction[1]

External assets and liabilities more than tripled as a share of GDP from the early 1990s to the years preceding the Great Lockdown (Figure 2.1). This sharp increase, both in gross and net terms, often referred to as the rise of "stock imbalances," has raised questions regarding its sustainability in debtor economies as well as the associated macroeconomic vulnerabilities when confronted with domestic and global shocks. The initial sharp tightening in global financial conditions and large terms-of-trade fluctuations caused by the outbreak of coronavirus (COVID-19) and the Great Lockdown led to sharp currency and current account movements in many economies—and, while in most cases the exchange rate was allowed to act as a shock absorber, a few countries resorted to foreign exchange intervention—as well as capital flow management measures to support macroeconomic and financial stability.

Figure 2.1. Stock Imbalances, 1990–2018

Gross external assets and liabilities are at record high levels.



Sources: External Wealth of Nations database (Lane and Milesi-Ferretti 2007); and IMF World Economic Outlook database.

Note: AE = advanced economies; EMDE = emerging market and developing economies.

[1]The authors of this chapter are Swarnali Hannan and Pau Rabanal (co-leads) and Luis Cubeddu, with contributions from Suman Basu, Roberto Perrelli, and Weining Xin, and support from Kyun Suk Chang, Deepali Gautam, Jair Rodriguez, and Zijiao Wang.

There is no clear consensus on which preexisting conditions pose the greatest risks of external stress nor the extent to which the effect of the composition of countries' external stock position matters, including the role played by the type of instrument (debt versus equity) and currency denomination. Numerous studies focus on predicting external crises based on such factors as current account deficits, exchange rate misalignment, credit growth, and the adequacy of international reserve coverage.[2] However, the role of the composition of the IIP has received less attention. Some studies, such as Catão and Milesi-Ferretti (2014), do consider how the structure of the IIP relates to the risk of external crises, but do not analyze the importance of currency composition. Data limitations may explain why previous research has not assessed this factor.

This chapter offers fresh evidence on these issues using a new data set on the currency composition of various types of external assets and liabilities. It investigates the relationship between these IIP components and the likelihood of an external stress episode, defined—as in a number of other studies—as an event that involves either a sovereign external debt default, debt restructuring, or recourse to an IMF arrangement. The chapter does not assess the overall costs and benefits of rising external assets and liabilities nor the associated process of international financial integration, but rather focuses on the country-specific risks related to the size and composition of their IIP. Financial integration can improve risk sharing, provide countries with capital for financing domestic investment, and enhance their ability to absorb shocks. At the same time, it may come with risks to macroeconomic and financial stability.[3]

Using standard statistical tools, the chapter attempts to answer the following questions:

- How do the size and composition of the various types of external assets and liabilities relate to the risk of external stress episodes? Is the relationship for emerging market and developing economies different from that for other (advanced) economies?
- What is the role of other well-studied variables, such as the level of global financial risk aversion and external current account balances, in explaining the likelihood of external stress episodes? How do these factors combine with the structure of the IIP in amplifying or mitigating risks?
- When an external stress event occurs, how does the size and composition of the IIP relate to the impact on output, the current account, and the exchange rate? How do external stress events impact creditor economies?

To address these questions, the analysis focuses on a sample of 73 advanced and emerging market and developing economies during 1991–2018. The chapter seeks to disentangle the role of certain IIP components in explaining external stress episodes, including: (1) gross and net external assets and liabilities, (2) equity and debt instruments, (3) the currency denomination of

[2]See Frankel and Rose (1996); Eichengreen, Rose, and Wyplosz (1996); Kaminsky, Lizondo, and Reinhart (1998); Kaminsky and Reinhart (1999); Obstfeld, Shambaugh, and Taylor (2009, 2010); and Frankel and Saravelos (2012).

[3]Such risks are especially prevalent where domestic financial markets are thin and policy frameworks do not adequately deal with financial excesses, as highlighted in other studies, such as Obstfeld, Shambaugh, and Taylor (2009, 2010); Rose and Spiegel (2009, 2011); Bruno and Shin (2015); Borio, James, and Shin (2016); and Coeurdacier, Rey, and Winant (2019).

external debt assets and liabilities, and (4) official and private foreign assets. The analysis goes beyond that of other studies by exploring the role of the aforementioned IIP components using a new data set on the currency composition of external assets and liabilities compiled by IMF staff in collaboration with authors at other institutions (Bénétrix and others 2019). To identify episodes of sovereign debt default or restructuring, the chapter uses updated versions of the data sets of Das, Papaioannou, and Trebesch (2011) and Asonuma and Trebesch (2016) as well as Paris Club reports.

The main findings of the chapter are as follows:

- Not all components of the IIP relate equally to the likelihood of external stress episodes. The net IIP declines in the run-up to an external stress episode and, the more negative it becomes, the greater is the likelihood of external stress materializing. However, within the IIP, the analysis can be usefully complemented by analyzing gross positions: in particular, gross external debt liabilities are stronger predictors of external stress than are equity liabilities or private external debt assets. Having a larger stock of foreign official reserves acts as a mitigating factor, lowering the likelihood of an external stress episode, although with diminishing effects.
- In addition, the type of gross external debt that matters most appears to differ across advanced and emerging market and developing economies. When the whole sample is considered, external debt liabilities are strong predictors of stress, irrespective of the currency denomination. But foreign-currency-denominated debt liabilities are particularly relevant for predicting external stress in emerging market and developing economies. Private sector holdings of external debt assets in foreign currency are also related to a lower risk of external stress, although only for emerging market and developing economies.
- Beyond the IIP structure, the analysis confirms the role of traditional external stress predictors, such as large current account deficits. Higher levels of global risk aversion increase external financing risks, suggesting an important role for global "push" factors in triggering external stress, especially in countries with preexisting external vulnerabilities.
- The chapter finds that the nature of external vulnerabilities for emerging market and developing economies have rotated over time. For example, while before the Asian financial crisis a central external vulnerability was a low level of international reserves, the central vulnerability ahead of the global financial crisis was more related to the size of current account deficits. In the years preceding the Great Lockdown, elevated gross external debt liabilities and their foreign-currency-denominated component were a central vulnerability for emerging market and developing economies, although relatively small current account deficits and relatively high levels of foreign exchange reserves helped mitigate these risks.
- Preexisting external vulnerabilities also amplify the macroeconomic costs of an external stress episode. For countries with large current account deficits, elevated foreign-currency-denominated debt, and low levels of reserves, real GDP falls by about 3.7 percent within two years of an external stress episode, while for countries with more limited external vulnerabilities, the decline in real GDP levels is typically less than 0.5 percent. Similarly, the

real effective exchange rate depreciates by about 10 percent and the current account balance rises by more than 2 percent of GDP within the first year of an external stress episode in countries with high preexisting vulnerabilities, with far more limited effects in countries with smaller preexisting vulnerabilities.

- Finally, the chapter also finds that external stress episodes have implications for creditor economies through valuation effects. Although ascertaining the costs for creditors is difficult, the analysis finds that following large global crises, such as the global financial crisis of 2008 and the euro area sovereign debt crisis of 2010—which featured a number of external stress episodes— creditor economies experienced valuation losses that lowered their IIPs. On average, in the decade following the global financial crisis, a 1 percent of GDP rise in the current account surplus has been associated with a 0.5 percent of GDP valuation loss—a systematic relationship that did not necessarily hold before the crisis.

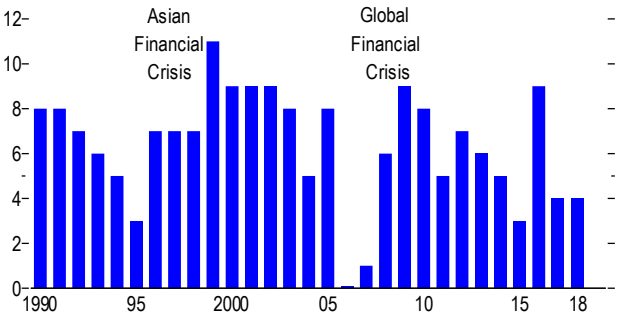
The remainder of the chapter is organized as follows. The first section presents empirical patterns of the main IIP components around external stress episodes. The second section discusses the main results from estimating an external stress probability model, focusing on the IIP and its main components, including how the combination of vulnerabilities increases the likelihood of external stress episodes. The third section computes costs for debtor and creditor economies after external stress episodes materialize, and the final section concludes by summarizing the chapter's implications for the outlook and risks.

International Investment Position Dynamics before and after External Stress Episodes

To understand the factors that influence external financing risks, the chapter focuses on the determinants of *external* stress episodes. As in Catão and Milesi-Ferretti (2014), episodes of external stress are defined as years in which an economy experiencs sovereign debt

Figure 2.2. External Stress Episodes in Selected Economies, 1990–2018
(Number a year)

External stress episodes are defined as sovereign debt defaults and restructurings, and/or access to IMF arrangements, for 73 advanced and emerging and developing economies.



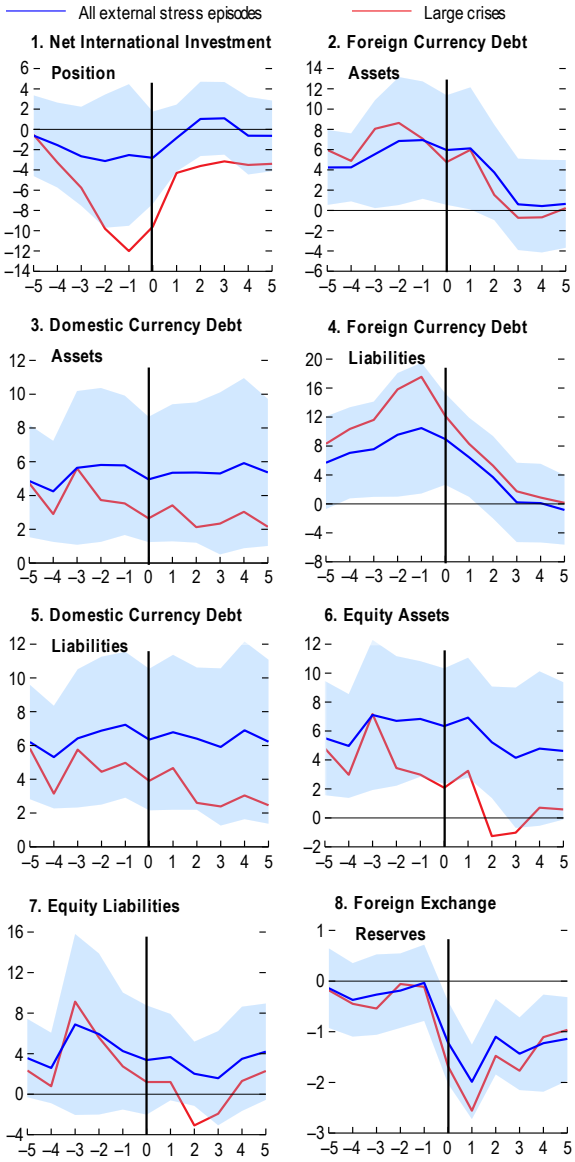
Sources: Das and others (2011); Asonuma and Trebesch (2016); Paris Club; and IMF staff calculations.

default or restructurings or the start of IMF-supported financial assistance. Sovereign debt defaults and restructuring episodes are identified based on an updated version of the data set in Das, Papaioannou, and Trebesch (2011) and Asonuma and Trebesch (2016); and recent Paris Club reports. Using the aforementioned criteria, the chapter identifies 176 cases of external stress (Figure 2.2), most of which involve emerging market and developing economies.[4] It is important to note that the chapter focuses on episodes of external stress, using the aforementioned definition, and not on fiscal stress or public debt crisis episodes. The latter would include, in addition to sovereign defaults and restructurings and recourse to IMF financing, additional events such as implicit default via high inflation and rising sovereign risk premiums (see Cerovic, Gerling, and Medas 2018).

The first part of the analysis studies the evolution of the main IIP components around external stress episodes. The sample comprises 73 advanced and emerging market economies during 1991–2018. This event-study analysis controls for country and time fixed effects to capture differences in countries' average IIP levels as well as the influence of common shocks (as in Gourinchas and Obstfeld 2012 and Catão and Milesi-Ferretti 2014;

Figure 2.3. Conditional Mean of the International Investment Position and Its Components around External Stress Episodes, 1990–2018
(Percent of GDP)

External stress episodes are usually preceded by a deterioration of the net international investment position and a large buildup of foreign-currency-denominated debt liabilities.



Source: IMF staff calculations.
Note: The methodology for construction of conditional mean estimates is based on Catão and Milesi-Ferretti (2014) and is discussed in Online Annex 2.1. Shaded area corresponds to the 90 percent confidence interval for all external stress episodes.

[4]One difference with Catão and Milesi-Ferretti (2014) is that it focuses on IMF-supported arrangements exceeding 200 percent of quota, while this chapter considers all IMF-supported arrangements, including nondisbursing and precautionary arrangements. Robustness on the inclusion of countries under a Flexible Credit Line is discussed in Online Annex 2.1. All annexes are available at www.imf.org/en/Publications/ESR.

see Online Annex 2.1 for details on the methodology and data sources).[5]

The results suggest that analyzing the information contained in gross positions can helpfully complement the information provided by the net IIP.[6] In the run-up to an external stress episode, the net IIP declines, driven predominantly by a sharp rise in foreign-currency-denominated external debt liabilities as a share of GDP (Figure 2.3, blue line), which in turn partially reflects currency depreciation dynamics. Domestic-currency-denominated debt liabilities also increase ahead of the stress episode, but by a smaller magnitude, while equity assets and liabilities decline gradually. Foreign-currency-denominated external debt assets also increase. Meanwhile, private foreign-currency-denominated external debt assets increase ahead of the stress episode, likely reflecting a combination of private capital flight and currency valuation effects, while official foreign exchange reserves decline sharply just ahead of the stress episode.[7] After the onset of an external stress episode, the net IIP typically rises, driven primarily by a significant drop in foreign-currency-denominated external debt liabilities likely associated with the necessary deleveraging and restructuring. Other IIP components exhibit smaller fluctuations or remain broadly unchanged, with the exception of official foreign exchange reserves, which typically decline in the aftermath of a stress episode and bounce back afterwards.

Similar, yet starker, dynamics of IIP components occur for a subsample of stress events defined as *large* external crises, which involve cases of IMF financial assistance exceeding 200 percent of quota (Catão and Milesi-Ferretti 2014). The drop in the net IIP ahead of the *large* external crisis is far more pronounced, driven even more importantly by a large rise in foreign currency-denominated debt liabilities. Similarly, declines in gross equity and official reserve assets are much sharper in these cases, and while they rebound, they end well below precrisis peaks.[8]

Estimating External Stress Probabilities

The analysis now investigates how the IIP components and other variables relate to the probability of an external stress event by estimating a pooled probit model (see Online Annex 2.1 for details on the statistical approach). The estimated specification is similar to that of Catão and Milesi-Ferretti (2014) and is extended to include the currency denomination of external assets and liabilities. The dependent variable is the occurrence of external stress (a value of 1

[5]The currency denomination of external debt assets and liabilities data set is available starting in 1991. This restriction determines the initial year of the sample.

[6]In the empirical analysis of the chapter, countries' net IIP corresponds to the net foreign assets variable in the Lane and Milesi-Ferretti (2007) data set, which excludes gold from the definition of foreign exchange reserves.

[7]On a net basis, foreign-currency-denominated assets (assets minus liabilities) tend to decrease before the stress episode, implying that the rise in foreign-currency-denominated debt liabilities outstrips the rise in private capital outflows.

[8]The magnitude of the estimates can vary if consecutive years with stress episodes are removed from the data set, but the trajectories are similar.

indicates a stress episode in a given country and year, while a value of 0 indicates no stress).[9] The explanatory variables include the various IIP components and standard macroeconomic variables identified in the empirical literature, such as the current account balance, global risk aversion, the real effective exchange rate gap (measured as deviations of the real exchange rate from the average of the previous five years), a measure of income per capita relative to the United States, the credit gap (constructed in a way analogous to the real exchange rate gap) and the degree of financial development.[10] The financial development index includes measures of market depth, access, and efficiency for each country, and can help explain cross-country differences in the ability to respond to external shocks (see Svirydzenka 2016). The sample is the same as for the event study of stress episode dynamics already mentioned.[11]

Estimation Results

In line with the event study analysis, a lower net IIP (a larger net debtor position) is associated with higher external stress (see Table 2.1, first column). When further disaggregating the IIP into its main components, the results suggest that both higher foreign and domestic currency external debt liabilities increase the probability of external stress events (see Table 2.1, second column). These results highlight the potential risks and costs of excessive external debt, either public or private. The estimated coefficients for the same external debt category in the IIP are different for assets and liabilities, denoting that gross positions, rather than net positions, provide useful information to assess the likelihood of external stress episodes. In addition, higher levels of foreign exchange reserves lower the occurrence of stress episodes. Private external debt assets do not appear to play a mitigating role. This result could reflect capital flight, which often rises in anticipation of external stress. Meanwhile, equity assets and liabilities are not statistically significant. Among other macroeconomic fundamentals, larger current account deficits are associated with higher external stress. The likelihood of external stress events also increases with global risk aversion, suggesting that global "push" factors also play a role.

There are important differences between the results for the entire sample, which includes both advanced and emerging market economies, and the sample that includes only emerging market and developing economies (Table 2.1, third and fourth columns). Foreign-currency-denominated debt liabilities have a statistically significant relationship with external stress risk for emerging market and developing economies, whereas domestic-currency-denominated debt liabilities do not. Another difference is the relation with private external debt assets denominated in foreign currency, which significantly reduce the probability of a stress episode in emerging market and developing economies. Taken together, these results highlight the importance of

[9]Gourinchas and Obstfeld (2012) compare the determinants of various crisis episodes, including sovereign defaults, systemic banking crises and currency crises. Box 2.1 presents work by IMF staff on predicting external crises using alternative definitions, including sudden stop episodes with high growth impact and exchange rate market pressure episodes.

[10]Several studies have used the Chicago Board Options Exchange Volatility Index (VIX) as a proxy for global risk aversion, with lower values indicating greater tolerance for risk taking and increases in leverage (Rey 2015). Following Obstfeld, Ostry, and Qureshi (2017), the VXO—the precursor of the VIX—is used to maximize data coverage.

[11]Data limitations preclude the inclusion of additional countries in the sample.

assessing currency mismatches in emerging market and developing economies. Equity assets and liabilities and external debt assets denominated in domestic currency do not play a statistically significant role. Finally, as before, current account deficits and global risk aversion increase the likelihood of external stress, while higher levels of foreign exchange reserves play a mitigating role.[12]

Table 2.1. Probit Estimates
(Estimation period: 1991 –2018)

Probability of External Stress (0/1; probit)	Full Sample		EMDE Sample	
NIIP/GDP	-0.28*		-0.63**	
Debt assets: Foreign currency/GDP		0.17		-0.83**
Debt assets: Domestic currency/GDP		-0.59		3.91
Debt liabilities: Foreign currency/GDP		0.38*		1.53***
Debt liabilities: Domestic currency/GDP		0.93***		2.51
Equity assets/GDP		0.18		-0.83
Equity liabilities/GDP		-0.28		-0.21
FX reserves/GDP		-3.54***		-3.91***
Current account/GDP	-5.64***	-6.32***	-4.92***	-5.15***
Global Risk Aversion (VXO)	0.01**	0.02**	0.02***	0.02***
Constant	-0.38	-0.69**	-0.93***	-1.13***
Number of Observations	1,838	1,828	1,014	1,004

Source: IMF staff estimates.
Notes: Dependent variable is probability of external stress event. Probit coefficients are presented in the table. Country-specific variables are lagged by one year. The current account/GDP is included as a two-year moving average. Additional controls include the credit gap, the real effective exchange rate gap, income per capita relative to the United States, and a financial development index. EMDE = Emerging Market and Developing Economies; FX = foreign exchange; NIIP = net international investment position; VXO = Chicago Board Options Exchange Volatility Index.
Significance levels are denoted by *** p<0.01, ** p<0.05, * p<0.1.

The central finding that external debt is a strong predictor of external stress episodes is robust to various definitions of external stress or crisis. Box 2.1 explores the correlates of two crisis types that differ from the external stress events already mentioned: (1) sudden stops with a high growth impact, and (2) exchange market pressure events. The analysis reported in Box 2.1 uses signal extraction and machine-learning techniques to predict these types of crises and compare their determinants. The results suggest that stock vulnerabilities, such as external debt measures, are reliable predictors of crises, although the ranking of candidate variables and the importance of interactions vary across crisis categories and country groups. The current account balance and the level of foreign exchange reserves are also relevant indicators for assessing other crises risks in advanced economies and emerging markets and developing economies.

[12]The main results in Table 2.1 are robust to incorporating additional control variables in the analysis, including global variables (interest rates and real GDP growth in the United States) and country-specific variables (the fiscal balance). The fiscal balance has significant explanatory power when other indicators that incorporate fiscal information, such as the current account balance and external debt, are excluded from the model. The relationship between short-term debt and external stress is found to be not robust, depending on data sources and the inclusion of other control variables. Moreover, a breakdown of the currency composition of short-term external debt is not broadly available.

Predicted Probabilities

To clarify the economic significance of the estimation results reported thus far, this subsection discusses predicted probabilities. These are computed by keeping all the variables in the estimated model constant at their sample means but changing the variable of interest in specified increments (for other applications of this approach, see, for example, Gourinchas and Obstfeld 2012). The estimation of these predicted probabilities (or margins) can uncover important nonlinear effects of some variables on the likelihood of external stress episodes.[13] In general, the estimated effects are economically more meaningful for the model estimated for emerging market and developing economies:

- An increase in foreign-currency-denominated debt liabilities from 40 percent of GDP (near the emerging market and developing economy median) to 60 percent of GDP is associated with an increase in the predicted probability of external stress by 6 percentage points. In the full sample of countries, this rise in debt would result in a much smaller probability increase (only 0.3 percentage point).
- A decline in the current account balance from a surplus of 5 percent of GDP to a deficit of 5 percent of GDP is associated with an increase in the predicted probability of external stress by 8.6 percentage points for emerging market and developing economies. For the full sample, the probability rises by only 2.3 percentage points.
- The relationship between official foreign exchange reserves and external stress is markedly nonlinear. The predicted external stress probability is near zero when reserves are above 55–60 percent of GDP. As reserves decline, the predicted external stress probability increases. A decline in foreign exchange reserves from 20 percent to 10 percent of GDP is associated with an increase in predicted external stress probability by 7.2 percentage points, while a further decline from 10 percent to 0 percent of GDP increases the predicted external stress probability by an additional 10.3 percentage points in the emerging market and developing economy sample. The corresponding values for the entire sample are much lower (1.3 percent and 2.5 percent, respectively).

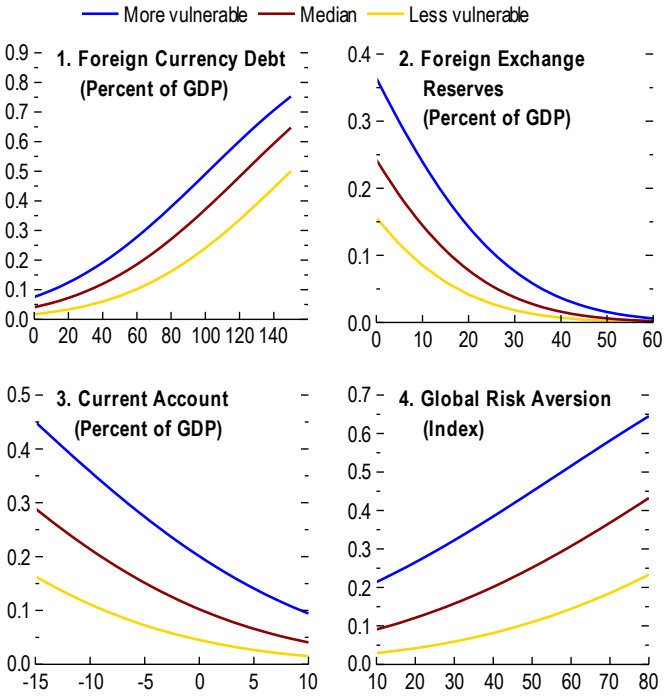
The finding that external vulnerabilities are more strongly related to risks of external stress for emerging market and developing economies has a number of potential explanations. This result reflects differences in the estimated coefficients and differences in the mean of some control variables between emerging market and developing economies and the full sample. For instance, the estimated coefficient on the effect of foreign-currency-denominated debt on the probability of an external stress event is about four times larger than for the full sample. In addition, the emerging market and developing economy sample has a lower average in the financial development index (see Svirydzenka 2016 for a detailed explanation). This index includes indicators that try to measure financial market depth, access, and efficiency, which are likely to help explain differences in countries' ability to weather external shocks.

[13]The results in this section are illustrative and should not be interpreted as the IMF's crisis prediction framework.

The results also imply that a combination of two or more external vulnerabilities greatly increases the probability of external stress for emerging market and developing economies (Figure 2.4).[14] The same level for foreign-currency-denominated debt liabilities could signal very different risks of an external stress episode, depending on other vulnerabilities. When foreign currency debt is 40 percent of GDP, the predicted probability ranges from 6–19 percent, depending on whether foreign exchange reserves and the current account balance are at high levels (75th percentile of the sample) or at low levels (25th percentile). Similarly, the vulnerabilities associated with large current account deficits depend on the levels of foreign exchange reserves and foreign-currency-denominated debt. The vulnerabilities associated with a low level of reserves are more severe in economies with a lower current account balance and higher level of foreign-currency-denominated debt.

Figure 2.4. Selected Predictors of External Stress in the Emerging Market and Developing Economies Sample
(Model-predicted probabilities)

The combination of external vulnerabilities in multiple dimensions can amplify external financing risks.



Sources: IMF, World Economic Outlook database; External Wealth of Nations database (Lane and Milesi-Ferretti 2007); Haver Analytics; and IMF staff calculations.
Note: All panels display the predicted probabilities of an external stress episode, keeping all covariates except foreign currency debt, foreign exchange reserves, the current account, and global risk aversion at their sample mean. More vulnerable countries are defined as those with foreign currency debt at the 75th percentile and foreign exchange reserves and current account balance at the 25th percentile of the sample. Less vulnerable countries are defined as those with foreign currency debt at the 25th percentile and foreign exchange reserves and current account balance at the 75th percentile. Median countries are defined as those with foreign currency debt, foreign exchange reserves, and current account balance at the median.

Finally, the estimated model has important implications for the risks facing emerging market and developing economies today. Global risk aversion increased sharply in the months following the outbreak of COVID-19, with negative implications for countries with preexisting external vulnerabilities. When global risk aversion reaches the peak values seen during the global financial crisis or the Great Lockdown, the predicted external stress episode probability for emerging market and developing economy with an average level of preexisting vulnerabilities rises to about 40 percent—more than double the estimated probability for less vulnerable emerging market and developing

[14]The analysis in Figure 2.4 excludes domestic-currency-denominated debt liabilities given that the estimated coefficient is not statistically significant for emerging markets and developing economies.

economies (see Figure 2.4). These results highlight the importance of preexisting conditions when global risk appetite sours.

External Stress Drivers over Time

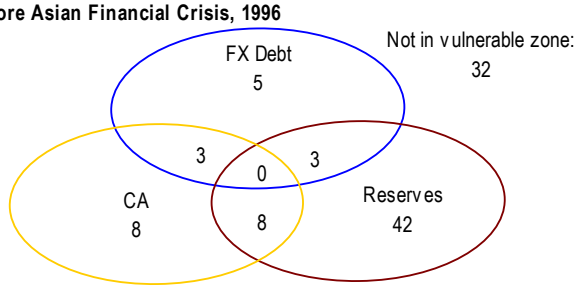
Having discussed which indicators are associated with external stress episodes, this subsection summarizes their configuration among emerging market and developing economies on the eve of three major crises affecting numerous economies: the Asian financial crisis (1998), the global financial crisis (2008), and the Great Lockdown of 2020. The analysis summarizes the configuration of the indicators using Venn diagrams (Figure 2.5). It indicates the proportion of emerging market and developing economies for which the aforementioned country-specific vulnerabilities (related to foreign currency debt, foreign exchange reserves, and current account deficits) are elevated as well as the proportion of those economies for which the indicators are at less vulnerable levels.

Before the Asian financial crisis, external risks were associated mostly with low levels of foreign exchange reserves and, to a lesser extent, large current account deficits. At the onset of the global financial crisis, external risks reflected mainly current account deficits and, to a lesser extent, foreign-currency-denominated debt liabilities. Low levels of reserves had become less of a vulnerability for most emerging market and developing economies at that point. In the years preceding the Great Lockdown, elevated foreign-currency-denominated debt liabilities became a central vulnerability for these economies. At the same time, this vulnerabilility was, in many cases, mitigated by relatively small current account deficits and relatively high levels of foreign exchange reserves.

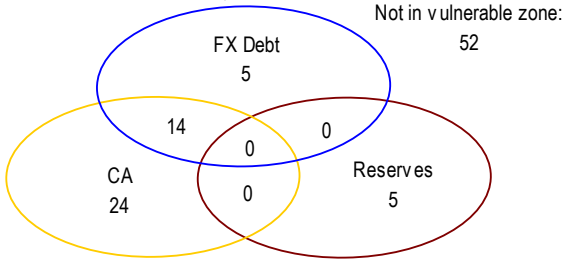
Figure 2.5. Rotating Sources of External Stress in Emerging Market and Developing Economies, 1990–2018
(Percent of sample)

The sources of external vulnerabilities have rotated overtime. Before the Asian financial crisis, countries at risk had low levels of foreign exchange reserves and large current account deficits. In recent years, vulnerabilities have been building through high levels of foreign-currency-denominated debt, but have been mitigated in most countries by a combination of smaller current account deficits and higher levels of foreign exchange reserves.

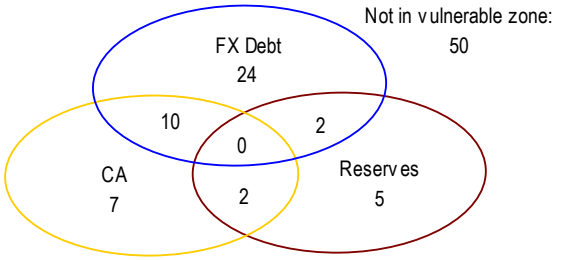
1. Before Asian Financial Crisis, 1996



2. Before Global Financial Crisis, 2007



3. Latest, 2018



Sources: External Wealth of Nations database (Lane and Milesi-Ferretti 2007); Bénétrix, Lane, and Shambaugh (2015); and Bénétrix and others (2019).
Note: CA = current account; FX = foreign exchange. Each Venn diagram reports the proportion of emerging market and developing economies that have a low level of foreign exchange reserves and current account balances (below the 25th percentile) and a high level of foreign exchange debt (above the 75th percentile) for 1996, 2007, and 2018. The current account balance is calculated as a two-year moving average.

Consequences of External Stress Episodes for Debtor and Creditor Economies

Having discussed the factors associated with external stress events and how their configuration has evolved over time, this section focuses on their macroeconomic consequences and how these depend on preexisting conditions.

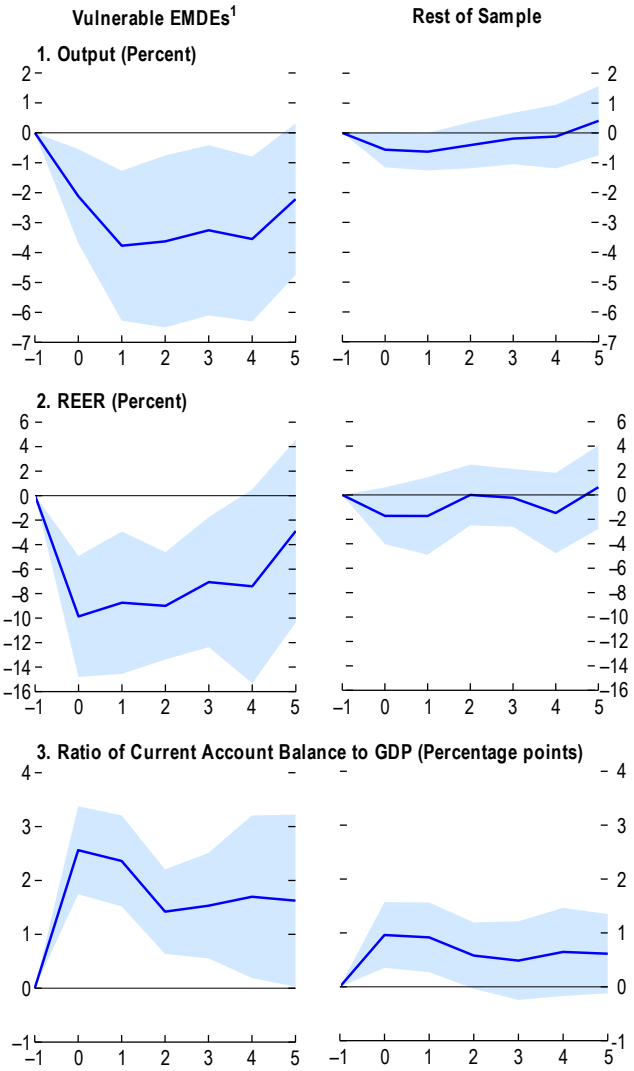
Consequences for Debtor Economies

In addition to affecting the likelihood of external stress episodes, it is plausible that external vulnerabilities would have a strong bearing on the macroeconomic consequences of external stress when it materializes. To investigate this possibility, this subsection focuses on the consequences for emerging market and developing economies using local projections following Jordà (2005).[15] The estimates illustrate the dynamic responses of real GDP, the real effective exchange rate, and the current account balance. For the purposes of the analysis, countries are again classified as having higher or lower vulnerabilities based on the preexisting level of foreign-currency-denominated debt liabilities, current account deficits, and foreign exchange reserves (see the definition in the note to Figure 2.6).

The results suggest that emerging market and developing economies with greater preexisting vulnerabilities tend

Figure 2.6. Evolution of Output, Real Exchange Rates, and Current Account Balances Following External Stress Episodes

Countries with preexisting vulnerabilities experience higher output costs of an external stress episode, as well as large exchange rate depreciations and a current account adjustment.



Source: IMF staff calculations.

Note: Estimates are based on the local projection method of Jordà (2005) as explained in Online Annex 2.1. Shaded area corresponds to the 90 percent confidence interval. The horizontal axis denotes time in years, and 0 is the year of the external stress episode. EMDEs = emerging market and developing economies; REER = real effective exchange rate.

[1]Vulnerable EMDEs are defined as those with foreign currency debt above the EMDE median, and current account balance and foreign exchange reserves below the EMDE median.

[15]The local projection method for each variable includes controls for country and time fixed effects and two-year lags of output growth, exchange rates, and the current account (see Online Annex 2.1 for additional details). The asymmetry is captured by interacting the stress episodes with a dummy that takes a value of 1 for countries with a high level of foreign-currency-denominated debt, a large current account deficit, and a low level of foreign exchange reserves, and 0 otherwise. In line with Chapter 4 of October 2009 *World Economic Outlook*, for this exercise, a country's vulnerability is based on the level of these three indicators compared with the sample median. The analysis in this section assumes that the factors associated with external stress episodes are the same as the preexisiting vulnerabilities that amplify their effect.

to experience larger output losses during an external stress episode (Figure 2.6). The output loss within the first two years for vulnerable economies is about 3.7 percent, well above the 0.5 percent estimated loss for economies identified as "less vulnerable." The recovery is also slower for vulnerable economies, with an output loss of about 2 percent five years after the external stress episode, while less vulnerable economies experience a recovery in their GDP levels within four years.

The effects on the real effective exchange rate and current account balance also relate to preexisting vulnerabilities. The real effective exchange rate depreciates by about 10 percent and the current account balance rises by more than 2 percent of GDP within the first year of an external stress episode for countries with high preexisting vulnerabilities. For less vulnerable economies, the real effective exchange rate and current account balance movements are much smaller.

Consequences for Creditor Economies

When debtors suffer external stress or a crisis, their creditors experience losses in the form of adverse exchange rate movements, lower asset and bond prices, and other valuation changes, including from debt restructuring and write-offs. This consequence for creditors is particularly visible in the years following the global financial crisis. According to the Laeven and Valencia (2012) banking crisis data set, creditor advanced economies, such as Belgium, Denmark, Germany, Sweden, and Switzerland, suffered a banking crisis in 2008, in part due to these economies' exposures to distressed assets in debtor economies.[16]

The analysis follows an aggregate approach, given data limitations, by studying the evolution of the valuation effects in the net IIP in the aftermath of large crises.[17] Valuation effects are estimated as the difference between the annual change in the net IIP and the financial account flows included in the balance of payments statistics for each country and year.[18]

The results indicate sustained valuation losses for countries with persistent current account surpluses in the aftermath of the global financial crisis that were not present in the precrisis period. Figure 2.7 (panels 1 and 2) presents the relationship between the accumulated current account balances of major economies and the estimated accumulated valuation effects,

[16]For instance, Hellwig (2018) documents German banking sector losses during the global financial crisis and euro area sovereign debt crisis as a result of exposures to distressed assets in Greece, Portugal, Spain, and the United States. The study's conclusion is that "the fiscal costs of support to German financial institutions were very large, even in comparison to countries that were epicenters of crises." Thévenoz (2010) discusses the case of Switzerland during the global financial crisis, including the government rescue of the Union Bank of Switzerland.

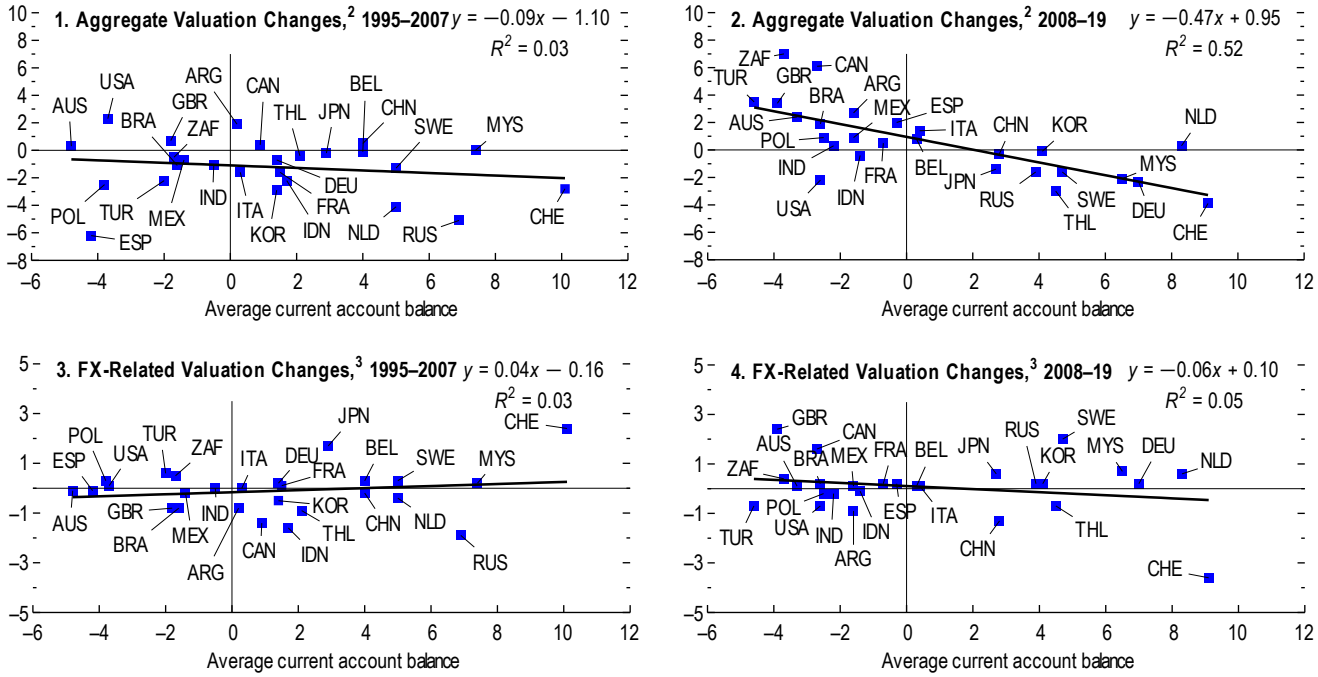
[17]Ascertaining the costs of each external crisis on each creditor economy would require estimating valuation changes at the security level for bilateral country exposures following each crisis.

[18]See Bergant (2017) or Adler and Garcia-Macia (2018) for details on this approach, which is known as the "residual" approach. A few countries, such as the United States and some euro area countries, publish valuation changes related to exchange rate fluctuations and asset price changes as well as other valuation changes as part of the stock-flow reconciliation tables between the IIP and balance of payments statistics. To increase country and time coverage, the residual approach is applied. Financial centers with large IIP positions are excluded (China: Hong Kong SAR and Singapore). Saudi Arabia is excluded because of data limitations.

comparing the periods before and after the global financial crisis.[19] The differences across subperiods are significant. In the precrisis period, there is no systematic pattern: sustained valuation gains or losses were not related to average current account balances.

Figure 2.7. Average Current Account Balances and Net International Investment Position Valuation Changes, 1995–2019[1]
(Percent of GDP)

Countries with persistent current account surpluses have experienced sustained valuation losses since the global financial crisis, while this relationship did not hold before the crisis. Valuation effects were not systematically related to exchange rates, but to other asset prices.



Sources: Bénétrix and others (2019); IMF, Information Notice System; IMF, World Economic Outlook database; External Wealth of Nations database (Lane and Milesi-Ferretti 2007); and IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes. FX = foreign exchange; NIIP = net international investment position.
[1]Country sample includes all *External Sector Report* economies excluding China: Hong Kong SAR, Saudi Arabia, and Singapore.
[2]NIIP valuation change = {(change of total asset − net acquisition of asset) − (change of total liabilities − net incurrence of liabilities)}/GDP.
[3]FX-related NIIP valuation change = −(net foreign exchange share in GDP * percent change in real effective exchange rate).

In the post-global-financial-crisis period, which also includes the euro area sovereign debt crisis of 2010, the relationship is negative and statistically significant. Countries with sustained current account surpluses (including Germany, Japan, and Switzerland, among others) experienced sustained valuation losses. The estimated slope coefficient of –0.5 implies that a sustained current account surplus of 2 percent of GDP led, on average, to a valuation loss of 1 percent of GDP a year. The implication of this result is that, in countries with sustained current account surpluses, the net IIP increases by less than would be expected from the cumulative

[19]These results are robust when a narrower window around the global financial crisis is considered (such as 2002–07 for the precrisis period and 2008–13 for the postcrisis period). The results are also robust when including the net international investment period in the beginning of each period instead of the average current account balance on the horizontal axis.

current account balances. On the contrary, for the pre-global-financial-crisis period, the coefficient is near zero and not statistically significant.[20]

The results highlight that the stabilizing role of valuation effects in the net IIP identified by Gourinchas and Rey (2007) and Adler and Garcia-Macia (2018) is especially strong after large systemic crises. On one hand, valuation gains can reflect adverse macroeconomic and financial factors. For example, euro area debtor economies (including Italy and Spain) generally experienced valuation gains following the global financial crisis. Greece and Portugal also experienced large valuation gains during this period that intensified after the euro area sovereign debt crisis.[21] These valuation gains correspond to losses for investors that had significant exposures to these economies. On the other hand, valuation losses can be the consequence of relatively strong underlying fundamentals. Since 2008 the United States has seen valuation losses despite continuing to run current account deficits. These valuation losses have been driven by (1) an appreciation of the US dollar, which reduces the value of US external assets denominated in foreign currency but does not affect liabilities, which are denominated in US dollars; and (2) better performance of equity valuations compared with peers (which leads to a higher value of US foreign equity liabilities and a lower net IIP).[22]

Finally, Figure 2.7 also estimates how much of these valuation effects reflects exchange rate fluctuations. Interestingly, for the two subperiods, there is no systematic relationship between current account balances and valuation changes resulting from exchange rates.[23] This is not to say that exchange rate fluctuations cannot have an impact on countries with large external creditor positions, such as Switzerland. However, when averaged over long periods of time, these valuation effects are not systematically related to the current account balance. This result suggests that factors linked to bond and asset price differentials, debt restructuring, and debt write-offs are driving the valuation effects.

Implications for the Outlook and Policies

This section summarizes possible implications of the chapter's results for economies in today's environment. For debtor economies, the results suggest that the ongoing period of global financial stress has increased the probability of experiencing external stress with either a debt

[20]The ratio of valuation changes to nominal GDP is estimated by converting both measures to US dollars, following the literature (see Devereux and Sunderland 2010, Bergant 2017, and Adler and Garcia-Macia 2018). The choice of the numeraire can affect the estimates. However, the results are quite similar when computing the ratio of valuation changes to nominal GDP when both measures are converted to domestic currency, in particular for economies with sustained current account surpluses.

[21]Greece and Portugal are not shown in Figure 2.7 because they are not economies reported in the *External Sector Report*. Ireland, in contrast, suffered valuation losses, although these estimates are imprecise, given that Ireland's IIP data are influenced by measurement issues related to the significant presence of multinational companies.

[22]Gourinchas, Rey, and Govillot (2010) argues that this phenomenon implies that the United States acts as a world insurer by transferring wealth to the rest of the world in crisis periods (via valuation losses). Given this role, Gourinchas, Rey, and Govillot (2010) argues that the United States should earn an insurance premium in the form of higher rates of return on its external assets compared with its external liabilities (an "exorbitant privilege") during tranquil times. Curcuru, Dvorak, and Warnock (2010) challenges this view and does not find evidence of a higher rate of return of US external assets over US external liabilities. See also Lane and Milesi-Ferretti (2008).

[23]The valuation changes due to exchange rate fluctuations are estimated using data on net foreign asset positions in foreign currency from the Bénétrix and others (2019) data set.

default, debt restructuring, or the need for IMF financial support. In a number of cases, these risks are already materializing. The chapter's findings suggest that the economies most at risk are likely to be emerging market and developing economies with preexisting vulnerabilities, such as a relatively high level of foreign currency external debt, large current account deficits, and a relatively low level of international official reserves. During spikes in global risk aversion, the overall risk of an external stress episode for such economies is several times greater than for emerging market and developing economies with relatively limited preexisting vulnerabilities. In addition, the macroeconomic consequences—in terms of lost real GDP and the sharpness of current account and real effective exchange rate adjustment—are likely to be significantly greater for economies with greater preexisting vulnerabilities when external stress episodes occur. The rise in debt ratios and fall in the level of foreign exchange reserves currently under way in a number of emerging market and developing economies could increase the near-term likelihood of external stress episodes. At the same time, as discussed in Chapter 1, the nature of the COVID-19 crisis is unique, with additional risk factors at play, including the evolution of the pandemic; sharp terms-of-trade movements; disruptions to economic activity, trade, travel, and remittances; and attendant implications for net exporters of commodities and tourism.

For creditor economies, the evidence suggests that running large and persistent current account surpluses comes with potential valuation losses in the aftermath of large systemic crises. Countries that entered the current crisis with large current account surpluses, while at a negligible risk of experiencing an external crisis themselves, may experience IIP valuation losses from their exposures to distressed assets or markets, as was the case during the global financial crisis.

Overall, for policymakers, the results imply that limiting a buildup of external vulnerabilities requires monitoring various components of external flows and the IIP. For countries where financing priority investment through external public and private sector debt is warranted, the analysis highlights the importance of limiting the foreign-currency-denominated component and currency mismatches by maintaining adequate buffers in the form of official and private sector reserves, even when the accumulation of foreign assets may carry the risk of valuation losses. An important consideration, highlighted in the April 2020 *Global Financial Stability Report*, is that increased foreign ownership of domestic currency debt can help reduce borrowing costs, but it may also increase price volatility where domestic markets lack depth. Monitoring currency mismatches appropriately requires timely data on the currency composition of external assets and liabilities. The analysis in this chapter uses a new data set compiled by IMF staff together with other institutions. Further efforts are needed to compile official data on currency composition, which would improve and stimulate further analysis in the future.

IMF staff already factor in excessive IIP and financing risk considerations when assessing external positions in the *External Sector Report*, particularly for large debtor economies. The chapter results can be used to further inform the external sector assessment process. The potential risks and costs associated with both large creditor and debtor positions highlighted in this chapter provide a further reason to take steps to avoid excessive and persistent current account imbalances over the medium term. The specific policies for avoiding such excessive imbalances differ across economies, as discussed in Chapter 3 of this report.

Box 2.1. Drivers of Various Types of External Crisis[1]

This box investigates the robustness of the chapter's findings on the drivers of external stress events or crises to alternative definitions. It also considers additional potential explanatory factors. The following events complement the external stress episodes studied in the chapter. These episodes feature capital outflows, exchange rate depreciation, and tighter financial constraints:[2]

- *Sudden stops with growth impact (SSGIs)*: During these episodes, a large decline in net private capital inflows tightens financial constraints sufficiently to generate unusually large recessions or lead to recourse to IMF financial support (following the work of Dornbusch, Goldfajn, and Valdés 1995 and Mendoza 2002, among others).
- *Exchange market pressure events (EMPEs)*: During these episodes, the currency sharply depreciates or reserves suddenly decline (as in Kaminsky and Reinhart 1999). Such events may imply different growth outcomes, depending on whether gains in export competitiveness are offset by the tightening of financial constraints due to foreign-currency-denominated debt.

The starting point of the analysis uses signal extraction methods to predict external crises given their potential for superior out-of-sample performance, as documented in Berg, Borensztein, and Pattillo (2005). This technique calculates a threshold for each variable separately, which enhances performance by reducing the impact of outliers and missing data but does not allow for variable interactions or more complex nonlinearities. Having established a benchmark, the performance of machine-learning techniques—which offer the potential to uncover novel nonlinearities and complex interactions among many variables—is explored.[3]

About 80 predictive indicators that cover various external crisis generations identified by the academic literature are explored (Table 2.1.1). Variable selection broadly follows the literature on generations of external crises, capturing a range of factors, including: (1) policy regimes, such as the exchange rate regime and capital account openness; (2) imbalances and mismatches, including the current account, balance sheet indicators, and private and public buffers; (3) asset price booms and busts, such as medium-term growth and acceleration of stock prices, house prices, and the real effective exchange rate; (4) global liquidity and contagion, such as US interest rates, spreads, volatility, banking linkages to other countries experiencing recent crises; and (5) political shocks.

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[1]The authors of this box are Suman Basu (IMF), Roberto Perrelli (IMF), and Weining Xin (University of Southern California), based on Basu, Perrelli, and Xin (forthcoming).

[2]SSGIs occur when the net private capital inflow as a percentage of GDP is at least 2 percentage points lower than in the two previous years with large multilateral support. EMPEs are defined as episodes where the weighted average of the annual percentage depreciation in the nominal exchange rate and the annual decline in reserves as a percentage of the previous year's GDP is below the 15th percentile of the worldwide pooled sample, with large multilateral support.

[3]Tree-based machine-learning models are an extension of the signal extraction technique: after the sample is split according to the threshold for one variable, subsamples continue to be split according to thresholds of other variables, generating an entire tree of threshold splits. The random forest model averages over a large number of randomly generated trees, whereas the RUSBoost model constructs new trees to capture the information left out of previously constructed trees. Machine-learning techniques discipline the construction of trees so that the maximization of in-sample model fit does not worsen out-of-sample performance. See Basu, Perrelli, and Xin (forthcoming).

Box 2.1 (continued)

The main results are that stock vulnerabilities are generally reliable predictors of external crises, whereas the ranking of indicators and the importance of interactions vary across crisis categories and country groupings. This may indicate that stock variables, being predetermined, are econometrically more sound. Figure 2.1.1 reports, for each type of crisis, the top indicators explaining in-sample variation for the prediction technique with the lowest sum of the percentages of false alarms and missed crises:[4]

- SSGIs in emerging market economies are well predicted by signal extraction methods. The most important predictors are debt liabilities and the asset price and credit bubbles they finance. The predictors include global factors (including the TED spread [the difference between the three-month US Treasury bill rate and the three-month LIBOR based in US dollars], the incidence of financial crisis in advanced economies, and interbank liabilities to banks in these advanced economies); medium-term bubbles (stock prices, house prices, and the real effective exchange rate); and external debt measures (scheduled amortization and cross-border interbank debt).

- EMPEs in emerging market economies, by contrast, are better predicted by machine learning techniques, implying that interactions between variables help sort through the more heterogeneous category of events. The best predictors come from several crisis generations models. External variables, such as reserve adequacy metrics, are complemented by measures of equity outflows that generate depreciations. In addition, fiscal vulnerabilities (EMBI sovereign spread, change in public debt) and competitiveness indicators (cumulative inflation) are highly important.

- EMPEs in advanced economies are well predicted by signal extraction techniques, and the most important predictors are indicators of external debt (private external debt, amortization, and the foreign currency and external shares of public debt).

- EMPEs in low-income countries are sometimes better predicted by signal extraction techniques and sometimes by machine learning, depending on whether foreign currency share data are included. If included, net open foreign currency share measures are important; other important predictors include indicators of first-generation currency crises (cumulative inflation, fiscal vulnerabilities, exchange rate regime), banking system health (share of non-investment-grade debt, capital-to-assets ratio), and—for countries where it is available—stock market overvaluation (price-to-earnings ratio). When foreign currency share data are not available, machine-learning methods deliver superior performance, and, in addition to the above variables, global factors (TED spread, US term premium) are identified as important.

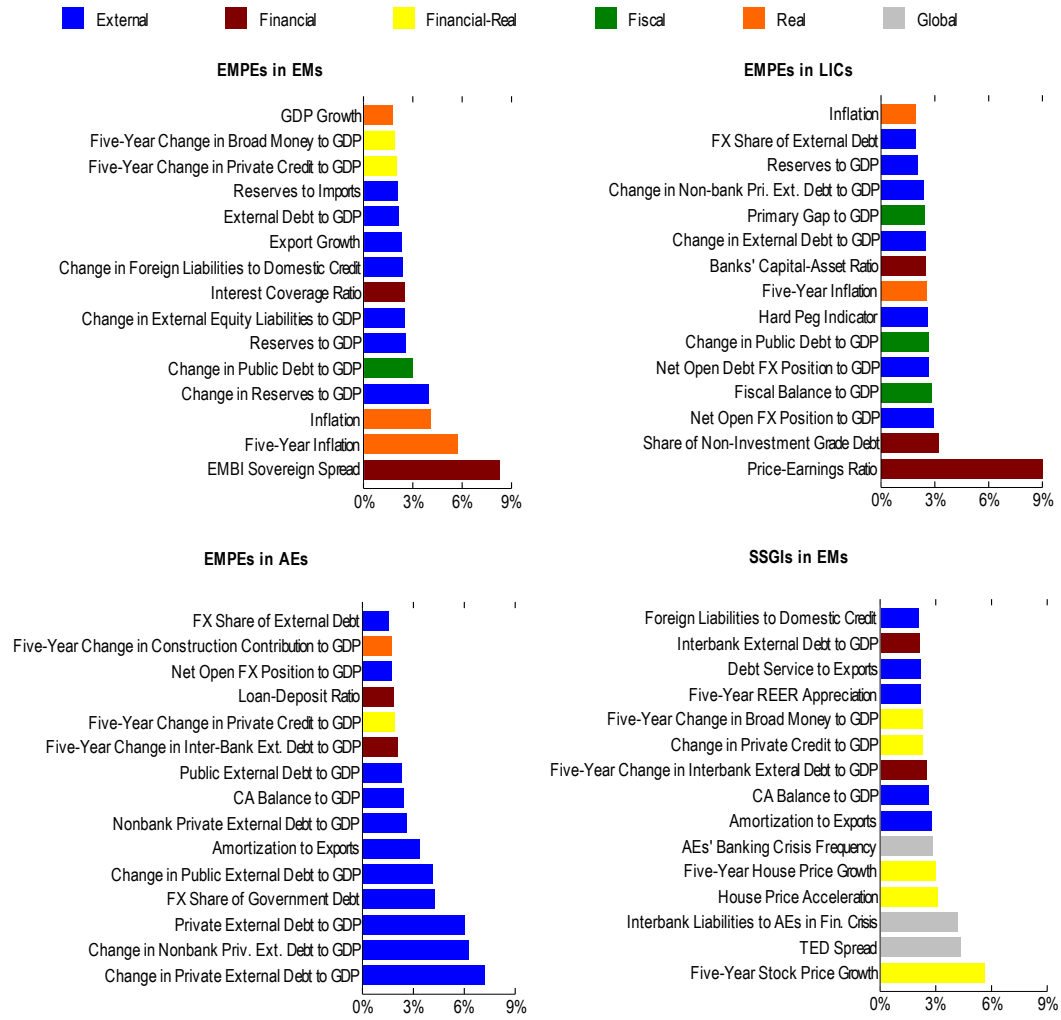
[4]The sample is not balanced, so missing variables are imputed using the machine-learning-based surrogate technique, which involves substituting available variables for variables that are not available. Both signal extraction and machine learning models are estimated with data from 1990 onward. The results are presented for the model that performs best with out-of-sample testing between 2008–17. The variable importance ranking is subject to the following caveats: (1) In machine learning, there may be slight differences in variable importance in different runs owing to random seed effects; (2) Using different subsets of variables can alter the ranking between signal extraction and machine learning; and (3) In-sample and out-of-sample variable importance rankings may vary.

Table 2.1.1. Set of Predictive Variables

First Generation	Third Generation: Liability Stocks	Third Generation: Medium-Term (Five-Year) Building Bubbles	Third Generation: Global Shocks
Fiscal balance/GDP	External debt/GDP	Private sector credit/GDP growth	VIX
Five-year change in M2/GDP	External debt/exports	Real housing price growth	US NEER change
Reserves/M2 and Reserves/GDP	Private external debt/GDP	Real stock price growth	US term premium
Dummies for hard peg and float	Bank external debt/GDP	REER growth	TED spread
Dummy for parallel market	Cross-border interbank liabilities/GDP	Cross-border interbank Liabilities/GDP growth	Federal funds rate (level and change)
	Private credit/GDP	External debt/GDP growth	
Second Generation	Total and external public debt/GDP	External equity liabilities/GDP growth	**Current Account Shocks**
Real GDP growth	Nonbank private external debt/GDP	Contribution of construction to GDP	Real growth in exports
Change in unemployment rate	External equity liabilities/GDP	Contribution of finance to GDP	Change in terms of trade
	Household liabilities/GDP		Reserves/imports
Third Generation: Flows and Mismatch	Foreign liabilities/Domestic credit	**Third Generation: Bursting Bubbles**	Absolute oil balance/GDP
Current account balance/GDP		Change in reserves/GDP	
Amortization/exports	**Third Generation: Buffers**	REER acceleration	**Law of One Price**
FX share of public debt	EMBI spread (level and change)	Real house price acceleration	Five-Year Cumulative Inflation
Debt service/exports	Primary gap/GDP	Real stock price acceleration	
Share of non-investment-grade debt	Corporate sector returns on assets	One-year changes in all liability stocks	**Political Shocks**
FX share of external debt	Corporate default probability		Political violence
Net open FX position/GDP	Interest coverage ratio		Successful coup
Net open FX debt position/GDP	Price/earnings ratio		
Inflow and outflow restrictions	Bank returns on assets	**Contagion**	
Reserves/short-term debt	Nonperforming loans	Change in export partner growth relative to five-year trend	
FX share of household and nonfinancial corporate credit	Banks' capital-asset ratio	Interbank liabilities/GDP to banks of AEs in financial crisis	
	Loan-to-deposit ratio inflation	Frequency of banking crises in AEs	
		Similarity to last year's crises	

Source: Basu, Perrelli, and Xin, forthcoming.
Note: AEs = advanced economies; FX = foreign exchange; NEER = normal effective exchange rate; REER = real effective exchange rate; TED spread = the difference between the three-month US Treasury bill rate and the three-month LIBOR based in U.S. dollars; VIX = Chicago Board Options Exchange Volatility Index.

Figure 2.1.1. Top Predictive Variables for Various Crises[1]



Source: IMF staff calculations.

Note: AEs = advanced economies; CA = current account; FX = foreign exchange; EMs = emerging market economies; EMPEs = exchange market pressure events; LICs = low-income countries; REER = real effective exchange rate; SSGIs = sudden stops with growth impact; TED Spread= the difference between the three-month US Treasury bill rate and the three-month Libor based in US dollars.

[1]The horizontal axes plot the variable importance metric from authors' calculations. The metric in the signal extraction model is the weight of the variable. The metric in the machine-learning model is the percentage of in-sample variation in the sum of errors explained by removal of the variable from the model-generated trees.

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EXTERNAL STRESS AND THE INTERNATIONAL INVESTMENT POSITION

Online Annex 2.1

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 Countries

Countries	Countries
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)
Norminal 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 176 cases of external stress episodes are identified, most of which involve emerging market and developing economies. This includes 159 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:

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

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 and IMF Flexible Credit Line 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:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta^H D^H_{i,t} Stress_{i,t} + \beta^O (1-D^H_{i,t}) Stress_{i,t} + \nu X_{i,t} + \varepsilon_{i,t,}$$

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,
- $D^H_{i,t}$ 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,
- $Stress_{i,t}$ 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.

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