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External Financing Risks: How Important is the
Composition of the International Investment Position?

by Luis Cubeddu, Swarnali Ahmed Hannan, and Pau Rabanal

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Research Department

**External Financing Risks: How Important is the Composition
of the International Investment Position?**

Prepared by Luis Cubeddu, Swarnali Ahmed Hannan and Pau Rabanal¹

Authorized for distribution by Luis Cubeddu and Daniel Leigh

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Abstract

Building on the vast literature, this paper focuses on the role of the structure of the international investment position (IIP) in affecting countries' external vulnerabilities. Using a sample of 73 advanced and emerging economies and new database on the IIP's currency composition, we find that the size and structure of external liabilities and assets, especially with regards to currency denomination, matter in understanding balance-of-payments pressures. Specifically, and beyond the standard macroeconomic factors highlighted in other studies, higher levels of gross external debt increase the likelihood of an external crisis, while higher levels of foreign-currency-denominated external debt increase the likelihood of sudden stops. Foreign reserve assets play a mitigating role, although with diminishing returns, and the combination of flow and stock imbalances amplifies external risks, especially during periods of heightened global risk aversion. The results are especially strong for emerging economies, where the impact of flow and stock imbalances and foreign currency mismatches are larger and more robust across specifications.

JEL Classification Numbers: E44, F32, F34, G15, H63

Keywords: international investment positions, foreign currency debt, current account, foreign reserves, sudden stops with large output loss, external crises.

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I. INTRODUCTION

Global financial integration, measured as the sum of gross external assets and liabilities, has more than tripled as a share of GDP since the early 1990s (Figure 1). If well managed, this integration can improve risk sharing, provide countries with the needed capital to fund domestic investment, and enhance their ability to absorb shocks. That said, it can also pose serious risks to macro-financial stability, especially in countries with weak policy frameworks and buffers, thin domestic financial markets and limited export capacity. (e.g. Borio et al. 2016, Bruno and Shin 2015, Kim 2012, and Coeurdacier et al. 2019). These risks have also been highlighted by other studies (e.g. Obstfeld et al. 2009, 2010, Rose and Spiegel 2009, 2011) on crisis early warning systems, which gathered momentum following the Global Financial Crisis (GFC).

Building on previous work on the determinants of external vulnerabilities, this paper examines the role of the size and structure of the international investment position (IIP) in affecting countries' likelihood of experiencing either an *external crisis*, which is defined as involving a sovereign default or restructuring, or recourse to IMF financing, or a *sudden stop with high adverse growth impact*.² In disentangling the role of the structure of the IIP, the paper emphasizes the differences between gross and net imbalances, equity and debt positions, the currency composition of external debt, as well as the role of official and non-official foreign assets in mitigating risks. While the focus is on disentangling how the different components of the IIP affect external vulnerabilities, the paper also examines the role of global factors as well as domestic macroeconomic fundamentals and policies already identified in the literature, such as the current account balance, the degree of exchange rate overvaluation, the fiscal position and the credit cycle. The paper, however, does not take a view on the determinants of currency composition, but rather studies how the structure of debt influences external financing risks.³

Using a sample of 73 advanced and emerging economies, and different statistical approaches (including event analysis and probit models), the paper finds that the high negative predictive power of a country's net IIP in explaining the likelihood of an external crisis or sudden stop event is predominantly driven by its gross debt liability position, with equity counterparts and non-official debt assets neither being statistically significant nor robust across specifications. The likelihood of an *external crisis* or a *sudden stop* event increases with the size of foreign currency denominated debt, especially for emerging market and developing economies (EMDEs).⁴ Foreign official reserves act as a mitigating factor to *external crisis*, although its impact is non-linear and with diminishing returns.

² Throughout the paper, we interchangeably use the terminology "sudden stops" and "sudden stops with high adverse growth impact (or high output declines)" to refer to these events.

³ Currency composition could be an endogenous outcome of policy settings and other country characteristics. As discussed by Engel and Park (2019), weak monetary and fiscal settings are correlated with the currency composition of debt (Calvo 1978, Jeanne 2003). Other studies (Eichengreen, Hausmann, and Panizza 2004, Hausmann and Panizza 2003), however, find a weaker empirical relationship between the foreign currency composition of debt and factors like the level of development, institutional quality, and monetary credibility

⁴ The effect of short-term external debt on external stress was also explored but found not to be robust to data sources and the inclusion other control variables. Data limitations prevented analyzing the role of both currency composition and maturity profile of external debt assets and liabilities.

Going beyond the IIP structure, and consistent with the existing literature, we find that higher current account deficits increase the likelihood of an external crisis, while an overvalued exchange rate, fiscal deficits, and excessive credit increase the likelihood of a sudden stop. Meanwhile, higher levels of global risk aversion, all else equal, increase the likelihood of both an external crisis or sudden stop event, confirming that global “push” factors also matter. Overall, the magnitude of the results is similar to what the existing literature deems as sizable and of economic significance (e.g. Gourinchas and Obstfeld, 2012).

Our estimations also reveal that a combination of vulnerabilities can amplify external risks. Specifically, the combination of a large stock of foreign currency denominated debt, a large current account deficit, and low foreign official reserves can significantly increase the likelihood of an *external crisis or sudden stop event*, and more so in periods of higher global risk aversion: The main findings of the paper survive a battery of robustness checks involving changes in the country sample, the definition of crisis episodes, and the inclusion of additional control variables.

The rest of the paper is organized as follows. Section II summarizes the literature. Section III provides a detailed description of external stress episodes, including data sources. Section IV discusses the results for external crises events, including event analysis, probit model estimates, and their macroeconomic impact. Section V presents a similar analysis for sudden stop episodes, focusing on the key similarities and differences with external crises events. Section VI concludes.

II. RELATED LITERATURE

Our work is related to a large body of literature on crisis early warning systems (Frankel and Rose, 1996; Eichengreen et al., 1996; Kaminsky et al., 1998; Kaminsky and Reinhart, 1999), which show that the size of the current account deficit, extent of real exchange rate overvaluation and inadequacy of reserve coverage as leading indicators of external crises. However, evidence from more recent studies is mixed. Rose and Spiegel (2009, 2011), which use a stricter crisis definition—involving large declines in real GDP, equity prices, exchange rate, and sovereign debt indicators—are unable to identify any specific variables that consistently explain the severity and cross-country incidence of crises. Meanwhile, Frankel and Saravelos (2012), using a similar crisis definition but a longer sample and an additional variable to capture “resort to IMF financing”, find that official reserve coverage (both relative to GDP and external debt) and the degree of currency overvaluation to matter the most, with external debt, the current account deficit, and credit growth also having some predictive power. This result is consistent with Obstfeld et al. (2009, 2010), who find that the ratio of reserves to M2 to be a useful predictor of sharp currency depreciations, although the predicted power varies considerably across samples.

Our paper is most closely related to a study by Catão and Milesi-Ferretti (2014), who use a probit model to examine the determinants of external crises with a focus on the importance of external liabilities and their composition. The authors find *net* external liabilities to be an important crisis predictor, but find no additional effect of including gross positions. We build on Catão and Milesi-Ferretti’s work in three dimensions: (i) apart from external crises, this paper studies the determinants of episodes of sudden stops with high adverse growth impact, (ii) this paper looks at the role of currency composition of external liabilities, and zooms into other IIP components, to

disentangle the role of gross assets and liabilities, (iii) it expands the set of control variables to identify other factors that impact the likelihood of external risk events.⁵ Importantly, our analysis goes beyond that of other studies by exploring the role of the aforementioned IIP components using a novel data set on the currency composition of external assets and liabilities compiled by Bénétrix and others (2019).

Our paper thus contributes to the literature by further enhancing our understanding of the role of IIP and its components in affecting external risks. Importantly, as far as we are aware, this is the first paper that uses a wide country and time coverage to assess in detail the relationship between the IIP currency composition and external financing risks, and estimates the output costs from external crises and their relationship to underlying pre-existing vulnerabilities.

III. DATA AND DEFINITIONS

The paper studies episodes of external stress (external crises and sudden stops) for a group of 73 advanced and emerging and developing economies (see Table A.1 in the appendix). Given data constraints, especially regarding the availability of data on the currency composition of external debt, the period considered is 1991-2018. The underlying data for the IIP (including foreign official reserves), current account, and nominal GDP are taken from the updated version of External Wealth of Nations database (EWN; Lane and Milesi-Ferretti, 2007), while the foreign currency shares of external liabilities are based on Bénétrix et al. (2019).⁶ Appendix Table A.2 includes the source of the variables used in the analysis.⁷

Two types of external stress episodes are considered: external crisis and sudden stops with high output declines.⁸

- **External crisis:** An external crisis is an episode of either a sovereign debt default or restructuring, or an IMF-supported program (excluding precautionary and nondisbursing arrangements). Sovereign debt defaults and restructuring episodes are identified based on an updated version of the data sets in Das, Papaioannou, and Trebesch (2011) and Asonuma and Trebesch (2016); and recent Paris Club reports. (<http://www.clubdeparis.org/en/traitements>). As shown in Table A.3, 128 cases of external crisis are identified, most of which involving EMDEs. The distribution of crisis episodes is evenly spread over the time horizon (Figure 2).

⁵ Other work using similar techniques includes Gourinchas and Obstfeld (2012) and Turrini and Zeugner (2019).

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. The dataset in Bénétrix et al. (2015) is used for those economies not included in Bénétrix et al. (2019).

⁷ "Net" is defined as asset minus liability positions, "equity" refers to the sum of foreign direct investment (FDI) and portfolio equity, and "debt" (either assets or liabilities) represent the sum of portfolio debt securities and other investment. Other investment excludes FDI intercompany debt, which is part of FDI.

⁸ The analysis considers episodes with consecutive years, although results are generally robust to an alternative episode definition, as shown in Section 4.B.

- **Sudden stops with high adverse growth impact:** As discussed in Basu et. al (forthcoming), based on the work of Dornbusch et. al (1995) and Mendoza (2002) among others, sudden stops with high growth impact represent episodes where a large decline in net private capital inflows tighten financial constraints, resulting in unusually large recessions or recourse to IMF financial support. In line with the literature (e.g. Catão, 2006; IMF, 2013), sudden stop episodes are defined as those where net private capital inflows are either: (i) 1½ standard deviation below their mean and the annual decline is ¾ standard deviations from a year earlier (defined in real U.S. dollars); or (ii) have declined by at least 3 percentage points of GDP relative to the previous year and 2 percentage points from two years earlier.⁹ Meanwhile, a large output decline episode is one where real GDP growth, relative to the average of the past 5-years, is in the bottom 5th percentile of the distribution (across time and across countries). As shown in Table A.4, 32 episodes involving a combination of sudden stops and large output declines were identified, many of them in large EMDEs. Interestingly, while sudden stop only episodes are evenly spread over the time horizon, those with large growth impact are far more concentrated (peaks during the GFC and the Asian Financial Crisis) and have been less visible in recent years (Figure 3).

IV. EXTERNAL CRISIS

A. Event Analysis: Pre- and Post-crisis IIP Dynamics

We start our analysis by studying the evolution of the main IIP components around external crisis episodes. The sample comprises 73 advanced and emerging market economies during 1991–2018.¹⁰ 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. 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:

$$y_{it} = \alpha_i + \beta_t + \sum_{s=-5}^5 \beta_s D_{t+s} + \varepsilon_{it} \quad (1),$$

where α_i and β_t are country and time fixed effects, respectively; D_{t+s} are dummy variables to identify when the crisis event occurs; and y_{it} is the IIP component under consideration. The coefficient β_s thus captures the extent to which the IIP component affects the external stress event.¹¹

As shown in Figure 4, which presents estimates for the evolution of key IIP components (together with 90 percent confidence bands), the deterioration of the net IIP as a share of GDP ahead of an external crisis seems to be driven predominantly by a sharp increase in foreign currency-denominated external debt liabilities, (which in part reflects valuation effects from currency

⁹ The underlying capital flow data comes from the IMF's Financial Flows Analytics database (which uses data the IMF's Balance of Payments Statistics, International Financial Statistics, and World Economic Outlook), the World Bank's World Development Indicators database, Haver Analytics, CEIC Asia database, and CEIC China database.

¹⁰ The currency denomination of external debt assets and liabilities dataset is available starting in 1991. This restriction determines the initial year of the sample.

¹¹ The 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 currency reserves.

depreciation, and lower real GDP growth in the years preceding the crisis). Meanwhile, foreign-currency external debt assets also rise, reflecting a combination of private capital flight and valuation effects, while foreign exchange reserves decline sharply just ahead of the crisis.¹² Equities play a mitigating role (in particular the value of equity liabilities falls ahead of crisis) while the rise in domestic-currency external indebtedness is much less pronounced. Following the crisis, net IIP typically rises, driven primarily by a significant drop in foreign-currency-denominated external debt liabilities, which likely reflects the necessary deleveraging and restructuring as well as some positive valuation effects from currency appreciation in the years after the crisis. The decline in foreign official reserves precedes the crisis but continues in its aftermath. Other components exhibit smaller fluctuations or remain essentially flat.

Similar, yet starker, dynamics of IIP components occur for a subsample of *large external crises*, which involve cases of IMF financial assistance exceeding 200 percent of quota. In these cases, the drop in net IIP is far more pronounced, driven even more important rise in foreign currency-denominated debt liabilities and decline in official reserve assets. That said, while IIP components also rebound more sharply following the crisis, they tend to end well below pre-crisis peaks.

B. Probit Estimation Results

A pooled probit model is used to study how the IIP and its components relate to the likelihood of external crisis events. The empirical approach is similar to Catão and Milesi-Ferretti (2014) and Turrini and Zeugner (2019), and is extended to include the currency denomination of external assets and liabilities. The dependent variable is the occurrence of an external crisis (a value of 1 indicates a crisis episode in a given country and year), and explanatory variables include various IIP components and standard macroeconomic variables, including the current account balance, the real effective exchange rate gap (measured as deviations of the real exchange rate from the average of the previous five years), relative income per capita, and a global risk indicator.¹³ The estimated specification includes additional controls, including (i) the credit gap (constructed analogously to the real exchange rate gap), to measure the role of financial excess; and (ii) the degree of financial development (an index measuring market depth, access, and efficiency, which is also interacted with relative income per capita). to account for differences in the ability to respond to external shocks (see Svirydzhenka 2016). The country and time coverages and crisis definition are same as in the event study analysis. All variables, except global risk aversion, are lagged one year to address endogeneity

¹² On a net basis, foreign-currency-denominated assets (assets minus liabilities) tend to decrease before the crisis, implying that the rise in foreign-currency-denominated debt liabilities outstrips the rise in private capital outflows.

¹³ 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.

issues.¹⁴ Regression results also report log pseudolikelihood and AUROC estimates to give a sense of goodness of fit and compare across specifications.¹⁵

In line with the literature, a negative net IIP position is associated with a higher likelihood of an external crisis, a result that is robust to the inclusion of additional controls (see Table 1, columns 1 and 5). When disaggregating net IIP into its main net components, we find that while net external debt and net foreign official reserves affect the probability of external crises, the net equity position does not (Table 1, columns 2 and 6). Moreover, when further disaggregating the net external debt components by currency, only the net foreign-currency-denominated debt component becomes significant (Table 1, columns 3 and 7). Finally, when focusing on the gross components of the IIP, foreign-currency denominated debt liabilities and foreign official reserves become the most robust and significant determinants (Table 1, columns 4 and 8).¹⁶ The log-likelihood and AUROC criteria suggest that the most disaggregated model with gross positions and additional controls is the one that fits the data best (Table 1).

Among standard macroeconomic variables, the current account balance (included in the regression as the lagged two year average) and global risk aversion (proxied by the VXO) are the most robust determinants of external crises and are always significant when included in the probit regressions (Table 1, columns 5 to 8). The financial development index is significant when the net IIP components are considered, as well as when the gross IIP components are considered, although it requires interacting financial development with relative income per capita. The real exchange rate and credit gaps appear with the correct sign in the regressions but are not significant in any of the specifications.

The main findings in Table 1, namely the importance of foreign-currency-denominated debt liabilities, foreign official reserves, current account balances and global risk aversion are robust to alternative specifications of the probit baseline regression. When limiting the sample to EMDEs (Table 2, column 2), the impact of foreign-currency denominated debt liabilities increases (consistent with the probability margin exercise in the next subsection), while other components like external debt in

¹⁴ The regression output Tables 1 and 2 show the specific transformation for the control variables. For example, the REER gap is expressed as the percentage change between the REER of a given year and its moving average over the last five years. Following Catão and Milesi-Ferretti (2014) the current account is included as the average of the past two years.

¹⁵ The AUROC is the Area Under the Receiver Operating Characteristic curve and can be regarded as an indicator of the goodness-of-fit of the model, with a higher AUROC estimate representing a better fit. The ROC (Receiver Operating Characteristic) curve is a model selection tool that plots the fraction of true positives versus the fraction of false positives along various threshold settings (values of a particular indicator). The true positives are the fraction of true occurrences that a given model signals (out of all the positives in the sample), while false positives are false alarms (model inaccurately signals external crisis occurrence when it does not happen) out of all the negatives in the sample. The AUROC is plotted by connecting all the points of true positives versus false positives under the ROC curve. See Schularick and Taylor (2012) and Catão and Milesi-Ferretti (2014) for a further discussion.

¹⁶ External equity assets become significant when controls are excluded. Meanwhile, equity liabilities and external debt denominated in local currency are significant when other controls are included.

domestic currency and equity positions drop in significance.¹⁷ Meanwhile, foreign official reserves serve a more important mitigating factor in crisis, yet crisis risks rise even more with higher current account deficits and levels of global risk aversion. Finally, the level of financial development and income per capita are not significant in the EMDE sample, likely reflecting the more homogeneous nature of this group. External assets held by the private sector play a limited mitigating role, suggesting these reflect resident capital flight that respond to weak policy frameworks and underlying vulnerabilities.¹⁸

The main results are also robust to a battery of alternative specifications. In particular, foreign currency-denominated debt liabilities are always statistically significant, and the magnitude is remarkably stable across alternative specifications.¹⁹ The first set of robustness checks involves changes in country sample, to exclude oil exporters and financial centers, and consider Spain's European Stability Mechanism (ESM) program (Table 2, columns 2, 3 and 4). The second set involves alternative definitions of the left-hand-side variable, such as: (i) focusing on large crises (IMF programs greater than 200 percent of quota); (ii) using a two-year window in defining a crisis, and (iii) excluding consecutive crisis years, both for the full sample and for the EMDE sample. The third set of alternative specifications involves having additional controls to consider the exchange rate regime, capital account openness, commodity price changes and the fiscal balance.²⁰ Only commodity prices are significant, and the inclusion of additional controls does not alter key results. Finally, windsorizing the data prior to estimation (1 percent for both tails), and estimating a logit regression delivers similar results.²¹

¹⁷ Domestic currency denominated debt in a country that does not have its own central bank—for example, because it is in a currency union—may pose similar risks as foreign currency denominated debt. If government debt is denominated in foreign currency, and there is a surge in risk premia (because investors are fleeing), the central bank cannot step in, lest it loses large amount of reserves. But if government debt is denominated in domestic currency, and the country does not have its own central bank (because it is in a currency union), the country may face exactly the same problem. During the euro area crisis, the euro area crisis countries experienced a surge in risk premiums and a very deep recession even though their external debt was all domestic currency-denominated (see Bakker, Korczak, and Krogulski, 2019).

¹⁸ Note that external assets denominated in local currency are excluded from the EMDE sample regression, as it exhibits insufficient variation. This variable takes a value of zero for about 50 percent of the sample, and it has a mean of 0.4 percent of GDP and a 75th percentile of 0.2 percent of GDP, reflecting that a majority of EMDEs do not hold external debt assets denominated in their own currency.

¹⁹ External debt liabilities denominated in local currency are not a robust crisis predictor across specification, partly reflects the fact that countries able to issue debt in their currency tend to have stronger fundamentals.

²⁰ As indicated in Table A.2, the exchange rate regime indicator is taken from IMF AREAER database. The indicator ranges from 0 to 10 in our sample, with higher number indicating more flexible exchange rate regime. Capital account openness is represented by Chinn-Ito index (ranging from 0 to 1, with a higher value indicating more openness).

²¹ Tables report logit with random effects (Hausman test fails to reject model with random effects), That said, results are robust to a logit specification that includes fixed effects.

C. Probit Margins

Predicted probabilities are computed by keeping all the variables in the estimated model fixed at their sample means, while changing the variable of interest in specified increments (for other applications of this approach, see, for example, Gourinchas and Obstfeld 2012). This estimation is useful in uncovering the nonlinear effects of certain variables on the likelihood of external crises. As shown in Figure 5, the estimated effects are economically more meaningful in the model estimated for EMDEs. Specifically:

- In the EMDE sample, an increase in foreign-currency-denominated debt liabilities from 40 percent of GDP (near the EMDE median) to 60 percent of GDP is associated with a 5-percentage point increase in the predicted probability of an external crisis. Meanwhile, in the full sample, this rise in debt would result in increases in the crisis probability by only 0.2 percentage points.
- 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 an external crisis by 5.3 percentage points for EMDEs. For the full sample, the probability rises by only 1.1 percentage points.
- The relationship between foreign official reserves and external crises is markedly nonlinear. The predicted external stress probability is near zero when reserves are above 30 percent of GDP. As reserves decline, the predicted external crisis probability increases. In EMDEs, a decline in foreign exchange reserves from 20 percent to 10 percent of GDP is associated with a 6.5 percentage point increase in the likelihood of an external crisis, while a further decline from 10 percent to 0 percent of GDP increases the predicted probability by an additional 12.6 percentage points. For the full sample, corresponding values for the entire sample are much lower (0.7 and 2.1 percentage points, respectively).
- Global risk aversion also has a differentiated and nonlinear impact depending on the sample. In EMDEs, a doubling of global risk aversion from its *historical* mean increases crisis predicted probabilities by 6.5 percentage points, with a further doubling to levels witnessed in the early phase of the Global Financial Crisis and the Covid-19 pandemic increasing predicted crisis probabilities by 23.5 percentage points. For the full sample, the probability rises by 0.7 and 4 percentage points, respectively.

The finding that external vulnerabilities are more strongly related to risks of external stress for EMDEs reflects differences in the estimated coefficients and mean of control variables across the full and EMDE sample. For instance, the estimated coefficient on the effect of foreign-currency-denominated debt on the probability of an external crisis is about four times larger than for the full sample. In addition, the EMDE sample has a lower average financial development index, which likely constrains a country's ability to weather external shocks.

The results also imply that a combination of two or more external vulnerabilities greatly increases the probability of external crisis in EMDEs (Figure 6). The same level for foreign-currency-denominated debt liabilities could signal very different risks of an external crisis episode, depending on other vulnerabilities. When foreign currency debt is 40 percent of GDP, the predicted probability

ranges from 2–13 percent, depending on whether foreign official 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 official reserves and foreign-currency-denominated debt. Predicted crisis probabilities associated with a current account deficit of 5 percent range from 2.5 to 21 percent depending on whether the economy is less vulnerable (with official reserves above the 75th percentile and foreign-currency-denominated debt below the 25th percentile) or more vulnerable (with official reserves below the 25th percentile and foreign-currency-denominated debt above the 75th percentile). A similar logic applies to the risks associated with low foreign official reserves, which are higher when current account deficits and foreign-currency-denominated debt are at high levels as well.

Finally, the estimated model has important implications for the global risks currently facing EMDEs. When global risk aversion reaches the peak values as seen in the initial phase of the Covid-19 pandemic (about 80, a value also reached during the Global Financial Crisis), the external crisis probability for an EMDE with median levels of preexisting vulnerabilities rises to about 40 percent—more than double the estimated probability for less vulnerable EMDEs (as defined previously). Results reaffirm the importance of external buffers to deal with global risk shocks.

D. Output Costs and Macroeconomic Effects of Crises

In addition to affecting the likelihood of an external crisis, high levels of foreign currency-denominated debt liabilities, high current account deficits, and low foreign official reserves may affect post-crisis macroeconomic outcomes and the speed of the subsequent recovery. To investigate this hypothesis, the asymmetry in post-crisis outcomes related to these indicators is analyzed using the local projections method (Jordà, 2005), which helps trace out the dynamic response of output, exchange rates and the current account after a crisis materializes, for the EMDE sample.²²

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 official reserves. In particular, the following specification is specified:

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

for horizons $k=0,1,\dots,5$ years and where:

- $y_{i,t+k}$ is the log of real GDP, the log of the REER, or the CA/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 denominated debt (above median of sample), high current account deficit (below median of current account balance), and low foreign official reserves (below median); and 0 for the rest of the sample,
- $\text{Crisis}_{i,t}$ is a dummy variable (1 for crisis and 0 otherwise),

²² 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.

- $X_{i,t}$ contains additional regressors: 2-year lags of the first difference of the log of real GDP, the log of the REER, and the CA/GDP ratio. Γ is the associated vector of estimated coefficients.
- ε is the regression residual.

The results suggest that EMDEs with a high vulnerabilities (a combination of high foreign-currency debt liabilities, high current account deficit, and low foreign official reserves) tend to experience higher and more protracted output losses following the crisis (Figure 7, top panels). Specifically, in vulnerable EMDEs the initial output loss is over 4 percent, and output remains below pre-crisis levels after five years. In the rest of the EMDE sample, initial losses are smaller (1 percent) and output rises to above pre-crisis level after four years. In addition (Figure 7, mid and bottom panels), more vulnerable EMDEs observe larger initial exchange rate depreciations (averaging 10 percent) and current account adjustment (averaging 2 percent of GDP). Overall, these results suggest that the post-crisis adjustment is larger when countries have multiple pre-existing external vulnerabilities, and the recovery is slower.

V. SUDDEN STOPS WITH HIGH GROWTH IMPACT

This section applies similar tools to understand the behavior and role played by IIP components around sudden stop events. The main differences with respect to the analysis of external crisis events are highlighted.

A. Event Analysis

The qualitative results (Figure 8) are similar to the case of external crisis. Sudden stops are preceded by (i) net IIP declines, which are mostly driven by increases in external debt liabilities denominated in foreign currency as percent of GDP (with currency depreciation and negative real growth also playing a role); and (ii) foreign official reserves declines, which continue in its aftermath, suggesting reserve sales are often used to buffer the impact of sudden stops. Meanwhile, external debt liabilities denominated in domestic currency are flat around sudden stop episodes, with equities following a similar path as in crisis episodes.

In quantitative terms, the magnitudes involved are much larger, suggesting that the identified sudden stop events are more severe than the identified external crises (Section IV A). The net IIP declines by more than 40 percentage points around a sudden stop episode, while it declines by about 3 percentage points for all external crises and by about 14 percentage points for large external crises, which involve cases of IMF financial assistance exceeding 200 percent of quota. Foreign-currency-denominated external debt liabilities increase by almost 80 percentage points for sudden stops, compared with 12 percentage points in the case of external crises and 22 percentage points in the case of large external crises.

B. Probit Estimation Results and Probability Margins

As in the case of external crisis events, deterioration in the net IIP position increases the probability of sudden stops, with statistically significant effects (column 1), driven both by an increase in net debt and net equity positions (Table 3). However, once foreign and domestic currency

components of net debt are considered, the net equity position loses statistical significance (columns 3, 4, 7, and 8), suggesting that sudden stops are driven by debt and its foreign-currency component. Higher net foreign-currency denominated assets reduce the likelihood of sudden stops, although the effect is mostly driven by lower gross foreign currency debt liabilities (columns 4 and 8). This finding is in line with the results of the event analysis, confirming that gross external debt liabilities are the main driver of IIP risks. Interestingly, domestic-currency denominated debt liabilities appear to mitigate such risks, likely reflecting (as discussed earlier) stronger policy frameworks and deeper capital markets, which in turn increase the ability to issue external debt in domestic currency.²³

Going beyond the IIP structure, the results from other macroeconomic variables are somewhat different from the cases of external crisis events. Overvalued exchange rates and excessive credit increase the likelihood of sudden stops (neither variable was significant in external crisis), while levels of global risk aversion play an even larger role. On the other hand, the impact of current account deficits and foreign official reserves are no longer statistically significant. The results are robust to the same battery of tests (Table 4), and the role of gross external debt liabilities is stable across specifications, including for EMDEs, where the results are stronger. In addition, and unlike the case of external crises, the fiscal balance is now a significant variable, with higher fiscal deficits increasing the probability of sudden stops.²⁴

Generally, the estimated probit margins for sudden stops are much lower than for the case of external crises, which suggests that they are rare events that are difficult to predict.²⁵ For instance, an increase of foreign currency denominated debt liabilities from 40 to 60 percent is associated with only a marginal increase in the probability of a sudden stop, yet the impact is non linear (increases with the size of FX denominated debt) and increases when combined with other vulnerabilities, especially in the EMDE sample. Only for the case of the global risk aversion indicator, we obtain predicted probabilities that are quantitatively similar to the case of external crises.

VI. CONCLUSION

This paper provides new evidence on the role of the structure of IIP in affecting countries' external financing risks. In particular, using an extended time and country coverage, and building on previous work on this area (Gourinchas and Obstfeld, 2012; Catão and Milesi-Ferretti (2014); Turrini and Zeugner, 2019), the paper focuses in quantifying the external risks associated with the structure of external liabilities., with emphasis on currency composition, The paper finds that the size and

²³ To shed further light on the apparently counterintuitive response of domestic-currency denominated currency debt, a similar exercise is performed focusing on "gross" private inflows (not "net" inflows). The estimated probit model shows that only the foreign-currency denominated debt liability component is now statistically significant, suggesting that domestic-denominated debt may help to mitigate private outflows.

²⁴ Basu, Perrelli, and Xin (forthcoming) study the most useful predictors of sudden stop events with high growth impact with machine learning techniques. In addition to the variables highlighted in Table 4, including REER misalignments, change in private credit to GDP, global factors and external debt indicators, they find that financial variables such as growth in stock prices and house prices, and the TED spreads help predict these types of events.

²⁵ The predicted probit margins are omitted to save space but are available upon request.

currency composition of the IIP matters, especially for EMDEs: higher external debt increases the likelihood of external crises, while higher foreign currency-denominated debt increases the likelihood of sudden stops. Official reserves act as a mitigating factor by reducing the probability of external crises, with diminishing returns. Our results also highlight the role of macroeconomic variables—higher current account deficit increases the probability of external crises, overvalued exchange rates and high credit and fiscal deficits increase the chances of a sudden stop with high growth impact. Higher global risk aversion increases the likelihood of both events. Finally, the combination of vulnerabilities in two or more variables amplify these risks non-linearly.

While the substantial financial integration in EMDEs over the last two decades has brought benefits due to factors such as improved risk sharing and access to much needed capital to boost potential growth, it also could make these economies susceptible to external stress if not properly managed. The results imply that monitoring vulnerabilities requires carefully assessing different aspects of flow and stock imbalances, including foreign currency denominated debt as well as mitigating factors like official reserve buffers. Nonlinearities in the combined effects of vulnerabilities suggest that guarding against the buildup of external debt, especially in foreign currency, should remain a priority, given its amplifying effects when external financing conditions and risk appetite sour. 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 crisis episodes occur. These vulnerabilities are also likely to be relevant for low-income countries (LICs) that have borrowed in foreign currency (by issuing Eurobonds, for instance) over the last decade. Data constraints prevented including more LICs in the analysis, but future research should aim at studying vulnerabilities for these countries as well.

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Table 1. Probit Estimates for External Crisis Events

Variables	1	2	3	4	5	6	7	8
Net IIP, share of GDP	-0.34* (0.19)				-0.27* (0.15)			
Debt, share of GDP								
Net debt		-0.55*** (0.21)				-0.50*** (0.16)		
Net foreign currency debt			-0.61** (0.25)				-0.52*** (0.17)	
Net domestic currency debt			0.13 (0.40)				-0.29 (0.36)	
Foreign currency debt assets				0.22 (0.33)				0.40 (0.29)
Domestic currency debt assets				-0.24 (0.49)				-0.27 (0.48)
Foreign currency debt liabilities				0.62** (0.28)				0.44** (0.21)
Domestic currency debt liabilities				0.12 (0.39)				0.75* (0.39)
Equity, share of GDP								
Net equity		-0.31 (0.23)	-0.29 (0.24)			-0.34 (0.40)	-0.32 (0.39)	
Equity assets				-1.99* (1.18)				0.34 (0.76)
Equity liabilities				0.39 (0.40)				-0.66** (0.26)
Foreign exchange reserves, share of GDP								
		-7.22*** (1.43)	-7.21*** (1.44)	-7.02*** (1.65)		-6.13*** (1.65)	-6.20*** (1.70)	-5.22*** (1.81)
Other variables								
Income per capita, relative to US					-3.92*** (1.00)	-2.90** (1.18)	-2.88** (1.18)	-1.28 (1.34)
Current account/GDP, 2yr MA					-5.32*** (1.52)	-5.71*** (1.54)	-5.73*** (1.53)	-6.89*** (1.50)
REER gap, relative to 5yr MA					-0.29 (0.44)	-0.34 (0.42)	-0.34 (0.42)	-0.19 (0.43)
Credit gap, credit/GDP compared to 5yr MA					0.90 (0.70)	1.14 (0.69)	1.12 (0.70)	0.59 (0.59)
Financial development index					-4.96*** (1.19)	-2.87** (1.22)	-2.72** (1.37)	-0.42 (1.34)
Fin. develop. * income per capita relative to US					5.76*** (1.70)	1.80 (2.16)	1.70 (2.21)	-5.03* (3.00)
VXO					0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)
Constant	-1.95*** (0.14)	-1.41*** (0.20)	-1.35*** (0.20)	-1.24*** (0.18)	-0.08 (0.34)	-0.08 (0.36)	-0.10 (0.37)	-0.67** (0.33)
Observations	1,828	1,828	1,828	1,828	1,828	1,828	1,828	1,828
Number of ifs_code	73	73	73	73	73	73	73	73
Log pseudolikelihood	-410.38	-385.51	-384.42	-377.31	-358.33	-342.39	-342.32	-333.29
AUROC estimates 1/	0.66	0.67	0.72	0.82	0.83	0.84	0.84	0.87

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All country-specific variables are lagged by one year.

Net refers to assets minus liabilities. Net debt, net equity, net foreign debt, and net domestic debt are computed using the underlying gross numbers.

1/The main regressions use stata command "xtprobit". Approximate AUROC estimates are calculated using stata command "probit" and then applying "lroc".

Table 2. Robustness Checks for External Crisis Events

Variables	Sample Variation						Episode Variation						Additional Controls				Estimation method	
	Baseline	EMDEs only	Exclude oil exporters	Exclude Iceland and Ireland	Exclude GFC (2008)	Include Spain ESM	Full Sample			EMDE sample			Exchange Rate Regime	Capital Account Openness	Commodity Prices	Fiscal Balance	Winsorize (1 percent both tails)	Logit
							Large crises only	Crisis over next two years	Exclude consecutive years	Large crises only	Crisis over next two years	Exclude consecutive years						
Debt, share of GDP																		
Foreign currency debt assets	0.40 (0.29)	-0.13 (0.47)	0.52 (0.34)	-0.51 (0.42)	0.56** (0.28)	0.37 (0.28)	0.51 (0.38)	0.28 (0.44)	0.50 (0.31)	0.59 (0.56)	-1.06* (0.56)	0.06 (0.45)	0.42 (0.29)	0.30 (0.32)	0.42 (0.30)	0.37 (0.36)	-0.01 (0.35)	0.95 (0.58)
Domestic currency debt assets	-0.27 (0.48)	... (0.48)	-0.41 (0.52)	0.37 (0.69)	1.01 (1.11)	-0.73 (0.63)	-1.08* (0.63)	0.25 (0.52)	-0.20 (0.49)	... (0.49)	... (0.49)	... (0.49)	-0.22 (0.51)	-0.50 (0.50)	-0.70 (0.50)	-0.57 (0.60)	0.03 (0.63)	-0.64 (0.97)
Foreign currency debt liabilities	0.44** (0.21)	1.78*** (0.33)	0.44** (0.21)	1.55*** (0.27)	0.63*** (0.22)	0.42** (0.20)	0.41** (0.20)	0.58** (0.29)	0.32* (0.18)	1.09** (0.47)	2.55*** (0.51)	1.52*** (0.31)	0.43** (0.20)	0.49** (0.22)	0.41** (0.20)	0.50** (0.20)	0.95*** (0.26)	0.86** (0.38)
Domestic currency debt liabilities	0.75* (0.39)	1.32 (2.04)	0.81* (0.42)	0.45 (0.44)	0.39 (0.61)	1.10** (0.52)	1.09** (0.46)	0.64* (0.38)	0.72* (0.39)	-0.21 (2.08)	2.22 (2.90)	1.35 (1.97)	0.73* (0.42)	0.94** (0.45)	1.08*** (0.39)	0.93** (0.45)	0.57 (0.40)	1.52** (0.76)
Equity, share of GDP																		
Equity assets	0.34 (0.76)	-0.52 (0.86)	0.30 (0.90)	-0.22 (1.38)	-2.49 (1.68)	0.16 (0.69)	-0.19 (0.82)	0.01 (0.98)	0.21 (0.82)	-0.92 (0.62)	-0.60 (0.80)	-0.54 (0.80)	0.40 (0.72)	0.29 (0.83)	0.25 (0.73)	0.36 (0.68)	0.02 (0.46)	0.59 (1.61)
Equity liabilities	-0.66** (0.26)	-0.56 (0.49)	-0.68** (0.29)	-0.60 (0.43)	-0.30 (0.35)	-0.51* (0.26)	-0.15 (0.38)	-0.88** (0.47)	-0.66*** (0.36)	0.42 (0.36)	-0.63 (0.58)	-0.67* (0.37)	-0.73*** (0.27)	-0.56* (0.30)	-0.46* (0.26)	-0.56 (0.34)	-0.50* (0.29)	-1.34** (0.58)
Foreign exchange reserves, share of GDP																		
	-5.22*** (1.81)	-5.47*** (1.81)	-5.64*** (1.87)	-5.36*** (1.84)	-5.74*** (1.85)	-5.29*** (1.80)	-5.55*** (1.77)	-5.66*** (1.98)	-3.40** (1.53)	-6.46*** (1.79)	-6.30*** (2.19)	-3.69** (1.46)	-4.85*** (1.74)	-5.34** (2.17)	-4.44** (1.77)	-5.28** (2.25)	-4.02*** (1.24)	-10.57*** (3.68)
Other variables																		
Income per capita, relative to US	-1.28 (1.34)	-1.05 (0.68)	-1.30 (1.54)	-0.74 (1.46)	-0.78 (1.72)	-2.12 (1.33)	-0.34 (1.41)	-2.95* (1.65)	-1.28 (1.19)	-1.02 (0.79)	-1.06 (1.01)	-0.98* (0.55)	-0.84 (1.36)	-1.00 (1.59)	-1.22 (1.25)	-0.71 (1.52)	-1.17 (1.33)	-1.80 (2.65)
Current account/GDP, 2yr MA	-6.89*** (1.50)	-5.10*** (1.33)	-7.31*** (1.68)	-6.06*** (1.49)	-5.74*** (1.50)	-6.60*** (1.45)	-7.08*** (1.86)	-8.48*** (2.66)	-7.55*** (1.60)	-4.69*** (1.73)	-7.38*** (2.45)	-5.71*** (1.42)	-6.81*** (1.50)	-7.22*** (1.85)	-7.42*** (1.50)	-5.78*** (1.72)	-6.93*** (1.51)	-12.75*** (2.89)
REER gap, relative to 5yr MA	-0.19 (0.43)	0.34 (0.43)	0.16 (0.60)	0.17 (0.42)	-0.20 (0.41)	-0.17 (0.43)	0.02 (0.59)	-0.33 (0.40)	0.19 (0.47)	0.25 (0.57)	0.35 (0.44)	0.68 (0.48)	-0.14 (0.39)	-0.13 (0.53)	-0.10 (0.44)	-0.55 (0.46)	0.25 (0.59)	-0.28 (0.78)
Credit gap, credit/GDP compared to 5yr MA	0.59 (0.59)	-0.68 (0.82)	0.61 (0.58)	-0.48 (0.69)	-0.38 (0.66)	0.44 (0.56)	1.12* (0.58)	1.80** (0.86)	0.14 (0.65)	0.36 (0.90)	-0.20 (1.04)	-1.31 (0.94)	0.95* (0.69)	1.56** (0.58)	0.49 (0.58)	1.57** (0.79)	0.15 (0.71)	1.38 (1.18)
Financial development index	-0.42 (1.34)	-1.17 (1.20)	-0.10 (1.39)	-0.05 (1.40)	0.30 (1.57)	-0.98 (1.34)	2.36* (1.35)	-2.03 (1.42)	-0.13 (1.01)	0.60 (1.25)	-2.79** (1.05)	-0.35 (1.38)	-0.16 (1.52)	-0.21 (1.27)	-0.16 (1.30)	1.34 (1.30)	-0.04 (1.38)	0.16 (2.56)
Fin. develop. * income per capita relative to US	-5.03* (3.00)	... (3.00)	-5.56* (3.35)	-4.97 (3.66)	-5.85 (4.62)	-2.60 (2.92)	-7.32** (3.33)	-1.97 (3.47)	-4.28 (2.67)	... (3.47)	... (2.67)	... (3.47)	-6.00** (3.01)	-5.95* (3.20)	-4.98* (2.86)	-7.76** (3.14)	-5.35* (2.93)	-11.98** (5.90)
VXO	0.02** (0.01)	0.02*** (0.01)	0.02** (0.01)	0.02*** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.01** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.02*** (0.01)	0.02** (0.01)	0.02** (0.01)	0.01* (0.01)	0.02** (0.01)	0.02** (0.01)	0.03** (0.01)
Exchange rate regime													0.01 (0.04)					
Capital account openness														0.02 (0.27)				
Commodity prices																		-0.11*** (0.03)
Fiscal																		0.14 (3.04)
Constant	-0.67** (0.33)	-1.24*** (0.27)	-0.72** (0.35)	-1.24*** (0.36)	-0.91** (0.44)	-0.50 (0.34)	-2.20*** (0.41)	0.16 (0.43)	-1.00*** (0.31)	-2.22*** (0.31)	-0.76* (0.44)	-1.58*** (0.24)	-0.90*** (0.32)	-0.85** (0.42)	-0.48 (0.31)	-1.39*** (0.38)	-0.94** (0.37)	-1.33** (0.61)
Observations	1,828	1,004	1,706	1,772	1,756	1,828	1,828	1,828	1,802	1,004	1,004	978	1,781	1,509	1,828	1,454	1,828	1,828
Number of ifs_code	73	41	68	71	73	73	73	73	73	41	41	73	65	73	72	73	73	73
Log pseudolikelihood	-333.29	-294.38	-313.80	-322.31	-315.55	-339.01	-213.19	-339.01	-298.35	-185.67	-366.14	-259.70	-318.83	-264.67	-329.62	-206.28	-330.72	-333.71
AUROC estimates 1/	0.87	0.81	0.87	0.88	0.88	0.86	0.85	0.88	0.83	0.79	0.82	0.79	0.87	0.87	0.88	0.87	0.87	0.87

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All country-specific variables are lagged by one year.

1/The main regressions use stata command "xtprobit". Approximate AUROC estimates are calculated using stata command "probit" and then applying "froc".

Table 3. Probit Estimates for Sudden Stops

Variables	1	2	3	4	5	6	7	8
Net IIP, share of GDP	-0.26*** (0.07)				-0.50 (0.35)			
Debt, share of GDP								
Net debt		-0.26*** (0.07)				-0.50* (0.27)		
Net foreign currency debt			-0.33*** (0.09)				-0.62*** (0.21)	
Net domestic currency debt			1.05*** (0.35)				1.86** (0.77)	
Foreign currency debt assets				0.09 (0.19)				-0.15 (0.37)
Domestic currency debt assets				0.84** (0.34)				1.88*** (0.65)
Foreign currency debt liabilities				0.34*** (0.08)				0.59*** (0.21)
Domestic currency debt liabilities				-1.40*** (0.51)				-2.50*** (0.77)
Equity, share of GDP								
Net equity		-0.26*** (0.09)	-0.06 (0.16)			-0.26 (0.44)	0.36 (0.50)	
Equity assets				-0.62 (0.43)				0.13 (1.03)
Equity liabilities				0.24 (0.23)				-0.27 (0.49)
Foreign exchange reserves, share of GDP								
		-0.42 (0.75)	-0.37 (0.84)	-1.45 (0.95)		0.37 (1.71)	0.85 (1.99)	-0.15 (1.88)
Other variables								
Income per capita, relative to US					4.46*** (1.39)	4.36*** (1.47)	5.23*** (1.61)	5.52*** (1.58)
Current account/GDP, 2yr MA					-2.81 (2.18)	-2.89 (1.94)	-3.15 (1.92)	-2.81 (1.89)
REER gap, relative to 5yr MA					2.89*** (0.67)	2.95*** (0.66)	3.03*** (0.64)	2.86*** (0.63)
Credit gap, credit/GDP compared to 5yr MA					4.31*** (1.23)	4.45*** (1.30)	4.68*** (1.29)	4.35*** (1.33)
Financial development index					0.05 (1.66)	0.01 (1.64)	1.60 (2.04)	2.59 (2.29)
Fin. develop. * income per capita relative to US					-6.79** (3.27)	-6.70** (3.36)	-9.60** (4.05)	-10.92** (4.49)
VXO					0.09*** (0.01)	0.09*** (0.01)	0.09*** (0.01)	0.09*** (0.01)
Constant	-2.38*** (0.14)	-2.36*** (0.16)	-2.31*** (0.16)	-2.16*** (0.17)	-5.61*** (0.76)	-5.66*** (0.71)	-6.12*** (0.75)	-6.17*** (0.72)
Observations	1,808	1,808	1,808	1,808	1,808	1,808	1,808	1,808
Number of ifs_code	73	73	73	73	73	73	73	73
Log pseudolikelihood	-156.03	-156.02	-152.90	-149.78	-105.47	-104.81	-101.69	-100.55
AUROC estimates 1/	0.60	0.61	0.64	0.73	0.92	0.92	0.93	0.93

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All country-specific variables are lagged by one year.

Net refers to assets minus liabilities. Net debt, net equity, net foreign debt, and net domestic debt are computed using the underlying gross numbers.

1/The main regressions use stata command "xtprobit". Approximate AUROC estimates are calculated using stata command "probit" and then applying "Iroc".

Table 4. Robustness Checks for Sudden Stops

Variables	Sample Variation				Episode Variation				Additional Controls				Estimation method	
	Baseline	EMDEs only	Exclude oil exporters	Exclude Iceland and Ireland	Full Sample		EMDEs only		Exchange Rate Regime	Capital Account Openness	Commodity Prices	Fiscal Policy	Winsorize (1 percent both tails)	Logit
					Exclude consecutive years	Crisis over next two years	Exclude consecutive years	Crisis over next two years						
Debt, share of GDP														
Foreign currency debt assets	-0.15 (0.37)	-1.32 (1.21)	-0.05 (0.39)	-0.68 (0.88)	-0.01 (0.33)	-1.34*** (0.40)	-0.86 (0.86)	-1.74** (0.86)	-0.13 (0.38)	-0.14 (0.34)	-0.36 (0.42)	-0.11 (0.41)	-0.08 (0.47)	-0.64 (1.49)
Domestic currency debt assets	1.88*** (0.65)	...	2.04*** (0.66)	-71.42*** (18.61)	1.56*** (0.52)	3.99** (1.64)	2.84*** (1.00)	1.86*** (0.58)	1.45*** (0.56)	1.32*** (0.51)	0.36 (0.57)	4.11*** (1.31)
Foreign currency debt liabilities	0.59*** (0.21)	1.60** (0.69)	0.54*** (0.20)	1.16** (0.56)	0.44*** (0.16)	1.49*** (0.43)	1.26* (0.67)	1.44 (1.06)	0.62*** (0.23)	0.54*** (0.20)	0.81*** (0.23)	0.46*** (0.17)	1.00*** (0.35)	1.35 (0.85)
Domestic currency debt liabilities	-2.50*** (0.77)	0.24 (3.21)	-2.61*** (0.78)	3.63 (2.87)	-2.06*** (0.64)	-5.61*** (1.72)	0.29 (2.94)	-0.34 (4.22)	-3.78*** (1.24)	-2.48*** (0.76)	-2.20*** (0.73)	-2.32*** (0.63)	-0.89 (0.60)	-5.15*** (1.51)
Equity, share of GDP														
Equity assets	0.13 (1.03)	2.61 (1.60)	0.21 (1.01)	3.79*** (0.96)	0.23 (0.80)	0.57 (0.96)	2.24 (1.58)	0.79 (1.67)	-0.04 (1.08)	0.05 (0.89)	0.13 (0.55)	0.09 (0.45)	-0.44 (0.87)	0.44 (2.31)
Equity liabilities	-0.27 (0.49)	-2.89** (1.44)	-0.44 (0.49)	-2.35*** (0.81)	-0.34 (0.44)	0.81 (0.80)	-2.55* (1.38)	-0.35 (1.71)	-0.32 (0.52)	-0.21 (0.42)	0.25 (0.50)	0.17 (0.37)	-0.08 (0.51)	-0.38 (1.26)
Foreign exchange reserves, share of GDP														
	-0.15 (1.88)	-6.83* (3.57)	-0.01 (1.74)	-2.54 (2.69)	-0.11 (1.68)	-1.74 (3.93)	-6.19* (3.24)	-6.47 (4.42)	-0.11 (1.81)	-0.02 (1.86)	0.51 (2.06)	-0.65 (1.95)	-1.60 (1.86)	-2.45 (12.28)
Other variables														
Income per capita, relative to US	5.52*** (1.58)	1.92 (1.66)	6.65*** (1.41)	5.08*** (1.59)	4.65*** (1.36)	10.24*** (2.69)	1.67 (1.49)	2.92 (2.29)	6.27*** (1.69)	6.42*** (1.31)	7.15*** (2.02)	5.41*** (2.04)	4.68*** (1.35)	12.76** (5.86)
Current account/GDP, 2yr MA	-2.81 (1.89)	-5.06 (3.82)	-2.31 (2.38)	-2.89 (2.57)	-2.71 (1.77)	-12.94* (7.08)	-4.81 (3.68)	-6.67 (5.74)	-3.41* (1.93)	-2.59 (2.03)	-4.66* (2.49)	-2.01 (1.80)	-1.04 (2.05)	-5.73 (3.80)
REER gap, relative to 5yr MA	2.86*** (0.63)	2.86*** (0.89)	2.87*** (1.09)	3.38*** (0.90)	2.65*** (0.59)	4.89*** (1.34)	2.66*** (0.81)	4.47*** (1.44)	3.08*** (0.68)	3.44*** (0.73)	3.56*** (0.80)	2.98*** (0.73)	4.59*** (1.29)	5.69*** (1.19)
Credit gap, credit/GDP compared to 5yr MA	4.35*** (1.33)	9.56*** (2.21)	4.42*** (1.33)	8.41*** (1.70)	3.52*** (1.15)	7.93*** (1.94)	8.88*** (2.06)	11.67*** (2.30)	4.71*** (1.50)	4.43*** (1.28)	5.05*** (1.47)	3.70*** (1.34)	7.58*** (1.51)	8.54*** (3.07)
Financial development index	2.59 (2.29)	0.55 (1.79)	3.16 (2.22)	2.93 (1.85)	2.37 (2.09)	1.25 (3.86)	0.63 (1.77)	-1.47 (3.04)	2.58 (2.31)	2.40 (2.08)	4.27* (2.43)	1.21 (2.34)	1.78 (2.38)	7.76 (10.66)
Fin. develop. * income per capita relative to US	-10.92** (4.49)	...	-12.85*** (4.25)	-10.60** (4.38)	-9.43** (3.92)	-16.39*** (6.31)	-11.75*** (4.56)	-11.88*** (3.81)	-14.91*** (5.21)	-9.36** (4.54)	-9.56** (4.16)	-28.08 (22.95)
VXO	0.09*** (0.01)	0.09*** (0.02)	0.09*** (0.01)	0.10*** (0.02)	0.07*** (0.01)	0.13*** (0.02)	0.08*** (0.02)	0.12*** (0.02)	0.09*** (0.01)	0.08*** (0.01)	0.12*** (0.02)	0.10*** (0.02)	0.08*** (0.01)	0.18*** (0.02)
Exchange rate regime									0.10* (0.06)					
Capital account openness										0.53* (0.29)				
Commodity prices											-0.34*** (0.09)			
Fiscal												-7.01** (3.38)		
Constant	-6.17*** (0.72)	-5.27*** (0.88)	-6.32*** (0.71)	-6.42*** (0.87)	-5.54*** (0.55)	-9.80*** (2.04)	-4.79*** (0.79)	-6.34*** (1.44)	-6.94*** (0.95)	-6.02*** (0.62)	-7.13*** (1.09)	-6.18*** (0.94)	-5.89*** (0.71)	-12.75*** (1.46)
Observations	1,808	999	1,691	1,752	1,804	1,828	997	1,004	1,762	1,495	1,808	1,443	1,808	1,808
Number of ifs_code	73	41	68	71	73	73	41	41	73	65	73	72	73	73
Log pseudolikelihood	-100.55	-63.06	-91.19	-78.29	-95.90	-135.60	-60.90	-92.63	-97.89	-91.00	-92.63	-67.01	-96.51	-100.82
AUROC estimates 1/	0.93	0.94	0.94	0.96	0.93	0.93	0.94	0.93	0.94	0.94	0.95	0.96	0.94	0.93

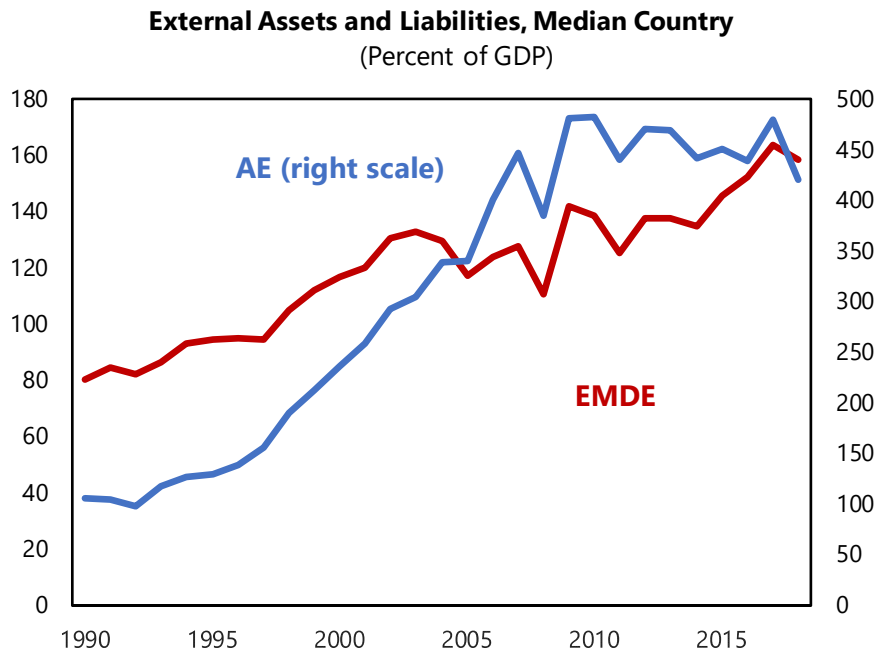
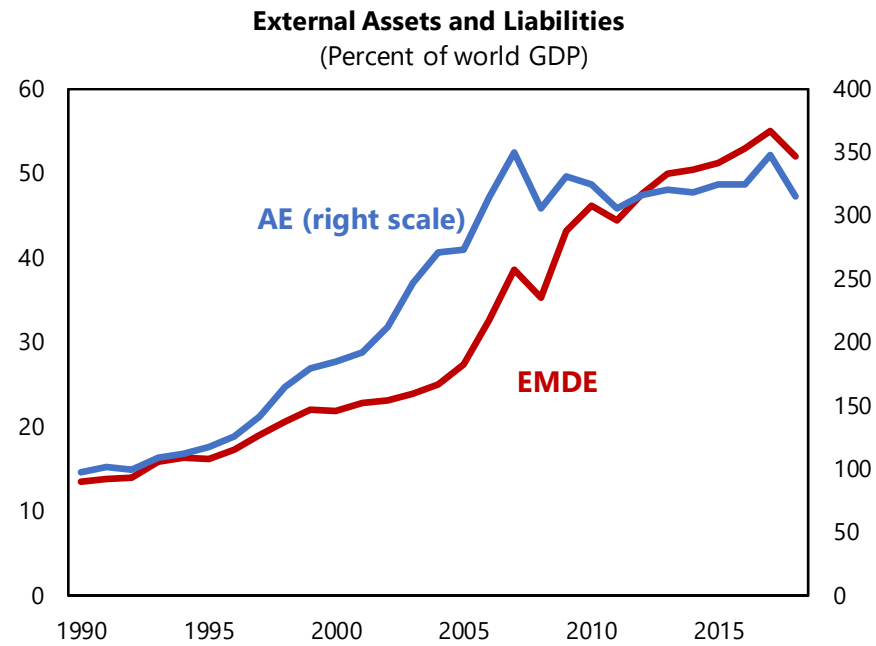
Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

All country-specific variables are lagged by one year.

1/The main regressions use stata command "xtprobit". Approximate AUROC estimates are calculated using stata command "probit" and applying "lroc".

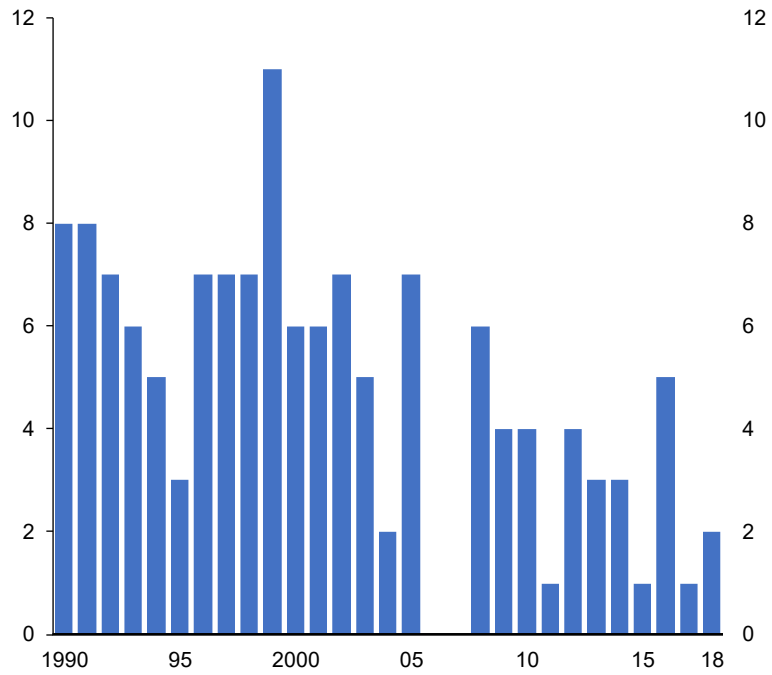
Figure 1. Stock Imbalances, 1990–2018



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

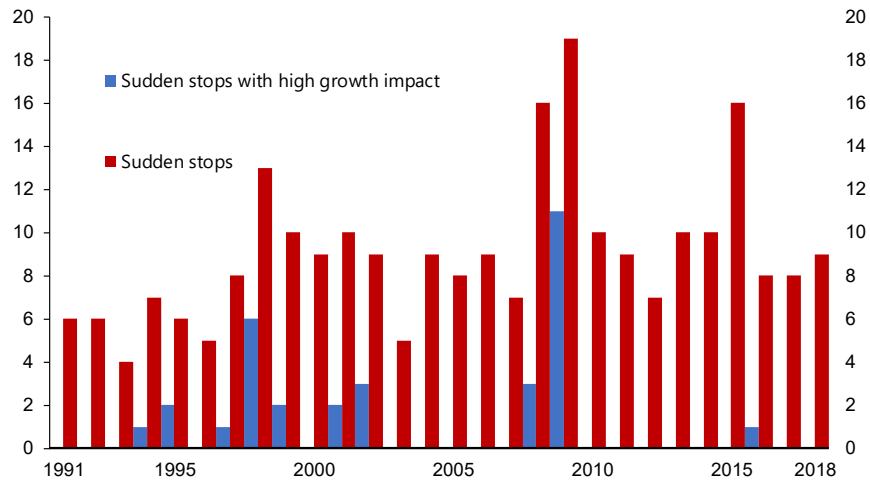
Note: AE = advanced economies; EMDE = emerging market and developing economies.

Figure 2. External Crisis Episodes, 1990–2018



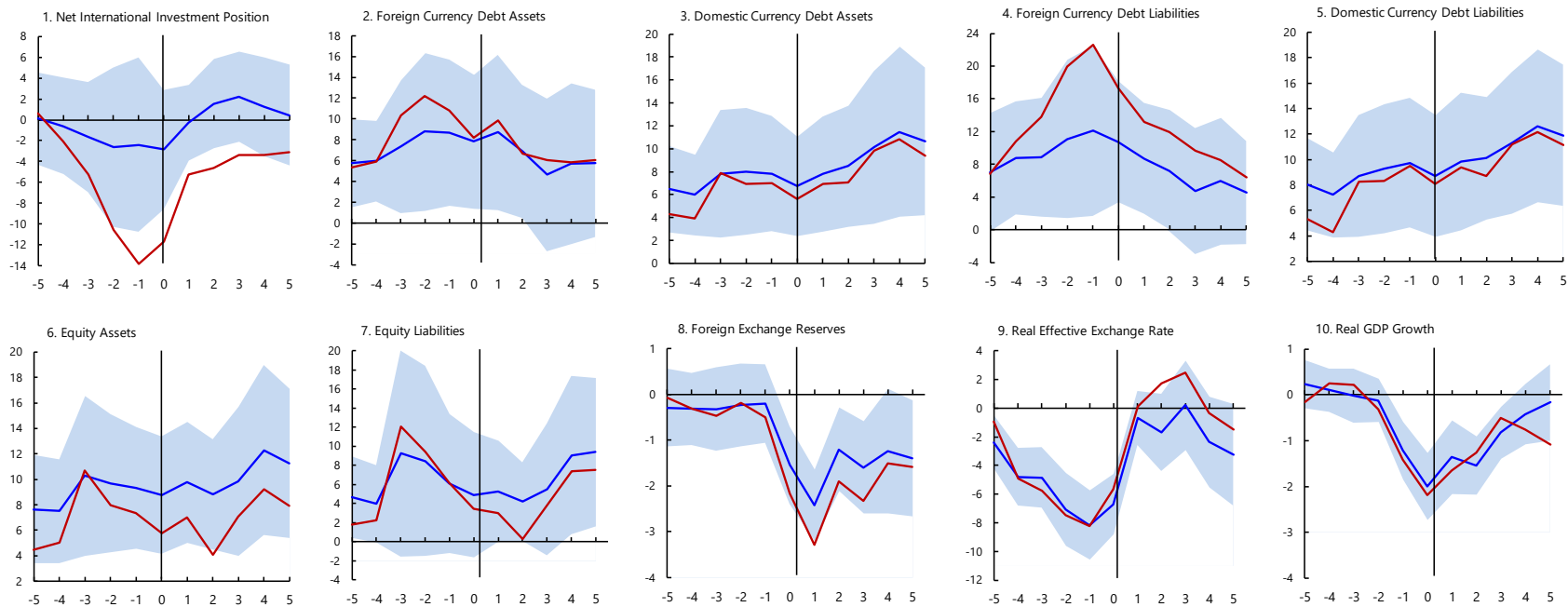
Sources: Das and others (2011); Asonuma and Trebesch (2016); Paris Club; and authors' calculations.

Figure 3. Sudden Stop Episodes, 1991–2018



Sources: IMF, World Economic Outlook database and authors' calculations.

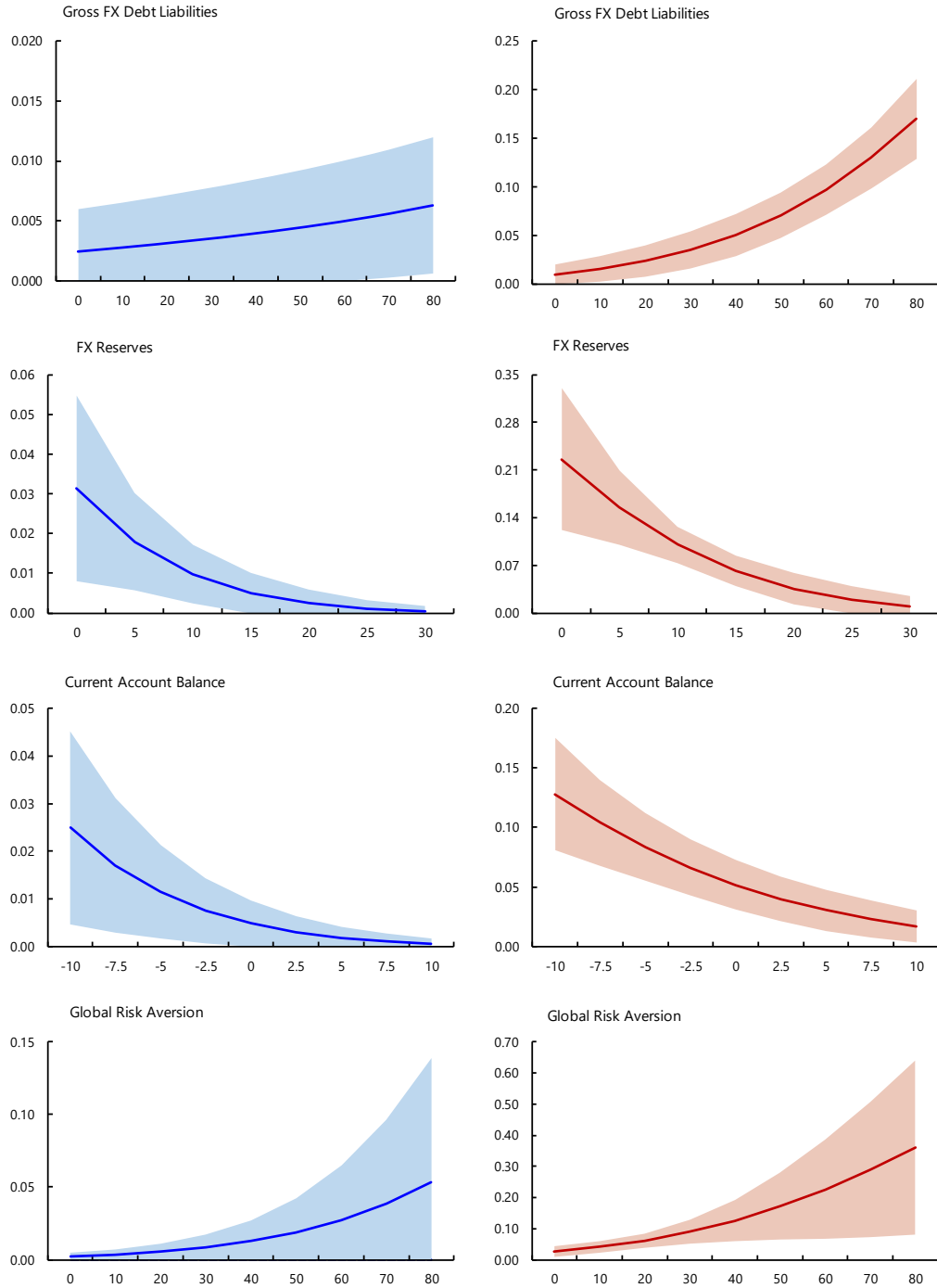
Figure 4. Conditional Mean of Key IIP Components, the REER and Growth Around External Crisis Episodes



Source: Authors' calculations.

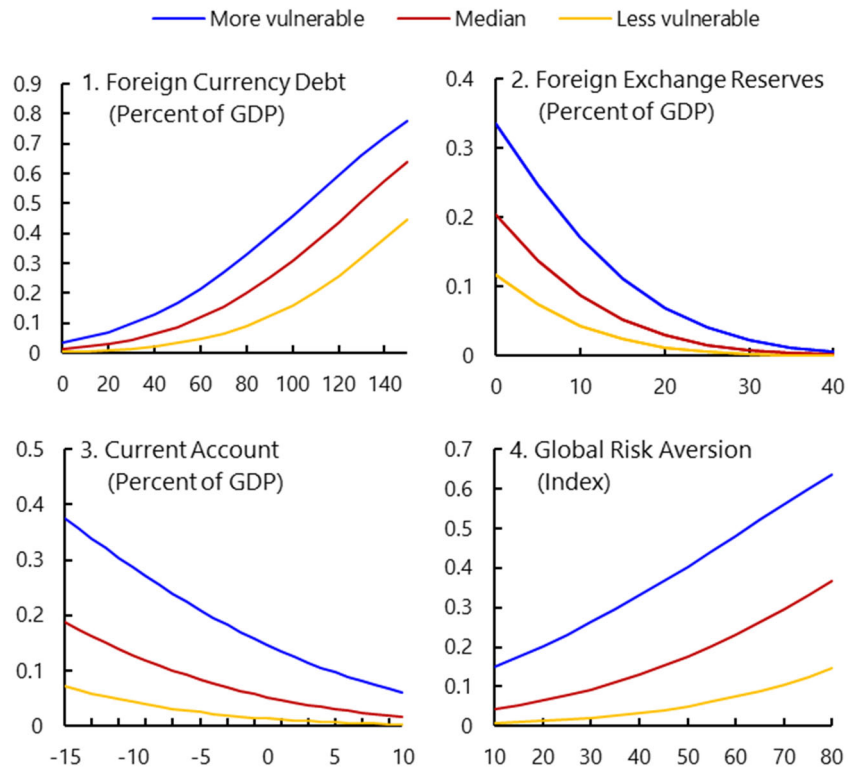
Note: The solid blue line corresponds to the mean of all external crisis episodes, while the blue shaded area corresponds to the 90 percent confidence interval. The red line corresponds to the mean of large crisis episodes. An increase (decrease) in the Real Effective Exchange Rate denotes appreciation (depreciation).

Figure 5. External Crises: Model Predicted Probabilities (Margins)



Note: All panels display the predicted probabilities of an external crisis episode, keeping all covariates except foreign currency debt, foreign exchange reserves, the current account, and global risk aversion at their sample mean. The solid blue line corresponds to the mean estimate, the dotted lines correspond to the 90 percent confidence interval.

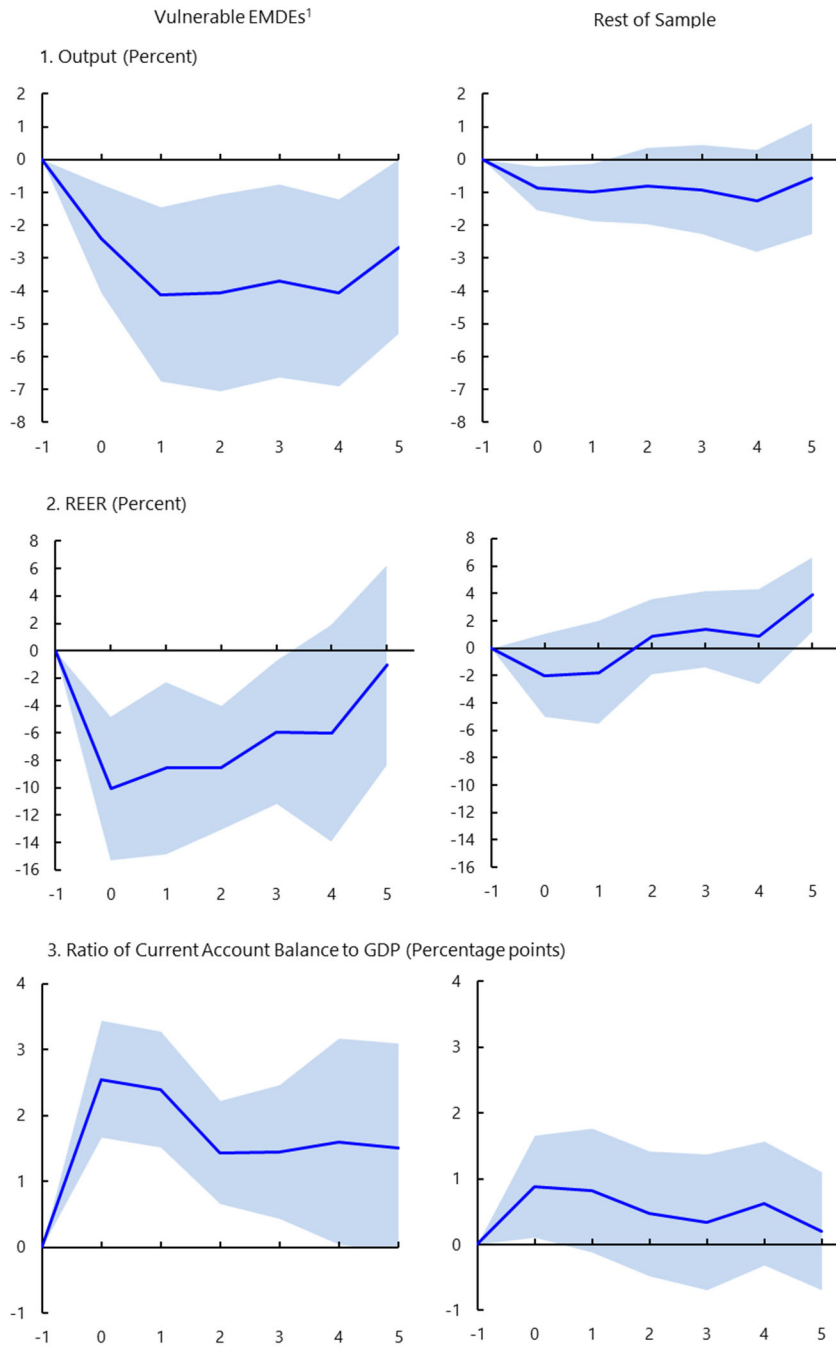
Figure 6. Selected Predictors of External Crises in the Emerging Market and Developing Economies Sample



Sources: External Wealth of Nations database (Lane and Milesi-Ferretti 2007); Haver Analytics; IMF, World Economic Outlook database; and authors' calculations.

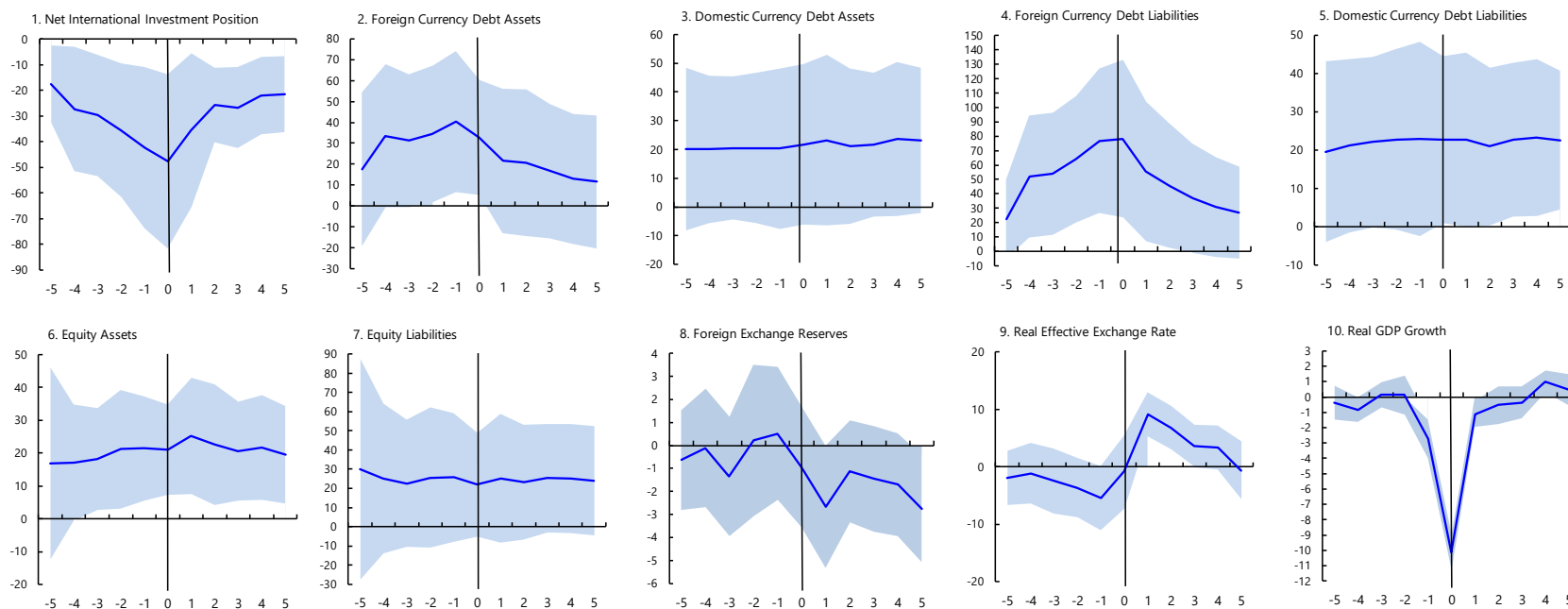
Note: All panels display the predicted probabilities of an external crisis episode, keeping all covariates except foreign currency debt, foreign exchange reserves, the current account, and global risk aversion at their sample mean. More vulnerable countries are defined as those with foreign currency 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.

Figure 7. Dynamic Evolution of Output, Real Exchange Rates, and Current Account Balance Following External Crisis Episodes



Note: Shaded area corresponds to the 90 percent confidence interval. The horizontal axis denotes time in years, and 0 is the year of the external crisis 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.

Figure 8. Conditional Mean of Key IIP Components, the REER and Growth Around Sudden Stop Episodes



Note: The solid blue line corresponds to the mean of all sudden stop episodes, while the blue shaded area corresponds to the 90 percent confidence interval. IIP components are expressed as percent of GDP. An increase (decrease) in the Real Effective Exchange Rate denotes appreciation (depreciation).

APPENDIX TABLES

Table A.1. Sample 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	Norway
Colombia	Oman
Croatia	Pakistan
Czech Republic	Peru
Denmark	Philippines
Dominican Republic	Poland
Egypt	Portugal
El Salvador	Romania
Estonia	Russia
FYR Macedonia	Singapore
Finland	Slovak Republic
France	Slovenia
Georgia	South Africa
Germany	Spain
Greece	Sri Lanka
Guatemala	Sweden
Hong Kong SAR	Switzerland
Hungary	Thailand
Iceland	Tunisia
India	Turkey
Indonesia	Ukraine
Ireland	United Kingdom
Israel	United States
Italy	Uruguay
Jamaica	Venezuela
Japan	Vietnam
Jordan	

Table A.2. Data Sources

Indicator	Source
IIP 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	Benetrix et al. (2019), Benetrix et al. (2015)
Private external debt defaults/restructurings	Asonuma and Trebesch (2016)
Official external debt restructurings	Das et al. (2011), Paris Club (http://www.clubdeparis.org/en/traitements)
Real effective exchange rate (2010=100)	IMF, Information Notice Systems
Income per capita	IMF WEO
Fiscal balance	IMF WEO and national sources
Credit	BIS, WDI
Financial development index	Svirydzenka (2016)
VXO	Haver
Exchange rate regime	IMF AREAER
Capital account openness	Chinn-Ito Index; Chinn and Ito (2006)
Commodity prices	S&P GSCI Commodity Index

Table A.3. External Crisis Episodes

Country	Year	Country	Year	Country	Year
Argentina	1991-92	Greece	2010	Pakistan	2013
Argentina	1996	Greece	2012	Peru	1991
Argentina	1998	Guatemala	1992-93	Peru	1993
Argentina	2000	Hungary	1996	Peru	1996
Argentina	2002-03	Hungary	2008	Peru	1999
Argentina	2014	Iceland	2008	Philippines	1991
Argentina	2018	India	1991	Philippines	1994
Bangladesh	2003	Indonesia	1994	Philippines	1998
Bangladesh	2012	Indonesia	1997-98	Portugal	2011
Belarus	2009	Indonesia	2000	Russia	1999
Bosnia and Herzegovina	2002	Indonesia	2002	Sri Lanka	1991
Bosnia and Herzegovina	2009	Indonesia	2005	Sri Lanka	2001
Bosnia and Herzegovina	2012	Ireland	2010	Sri Lanka	2003
Bosnia and Herzegovina	2016	Jamaica	1991-93	Sri Lanka	2005
Brazil	1992	Jamaica	2010	Sri Lanka	2009
Brazil	1998	Jamaica	2013	Sri Lanka	2016
Brazil	2001-02	Jamaica	2016	Thailand	1997
Colombia	1999	Jordan	1992	Tunisia	2013
Dominican Republic	1991	Jordan	1994	Tunisia	2016
Dominican Republic	1993	Jordan	1996-97	Turkey	1994
Dominican Republic	2003-05	Jordan	1999	Turkey	1999
Dominican Republic	2009	Jordan	2002	Turkey	2002
Egypt	1996	Jordan	2012	Turkey	2005
Egypt	2016	Jordan	2016	Ukraine	1998-01
El Salvador	1992-93	Kazakhstan	1999	Ukraine	2004
El Salvador	1995	Korea	1997	Ukraine	2008
El Salvador	1997-98	Latvia	1999	Ukraine	2010
FYR Macedonia	2000	Latvia	2008	Ukraine	2014-15
FYR Macedonia	2003	Mexico	1995	Ukraine	2018
FYR Macedonia	2005	Mexico	1999	Uruguay	1992
Georgia	2001	Nigeria	1991	Uruguay	1996-97
Georgia	2004	Nigeria	2005	Uruguay	1999-00
Georgia	2008	Pakistan	1993-95	Uruguay	2002
Georgia	2014	Pakistan	1997-01	Uruguay	2005
Georgia	2017	Pakistan	2008	Venezuela	1996
				Vietnam	2001

Table A.4. Sudden Stop Episodes (with High Output Decline)

Country	Year	Country	Year
Argentina	1995	Mexico	1995
Argentina	2001-02	Mexico	2009
Colombia	1999	Peru	1998
Croatia	2009	Singapore	1998
Estonia	2008-09	Slovak Republic	2009
Georgia	2009	Thailand	1997-98
Hungary	2009	Turkey	1994
Iceland	2009	Turkey	2001
Indonesia	1998	Turkey	2009
Ireland	2008	Ukraine	2009
Korea	1998	Uruguay	2002
Latvia	2008-09	Venezuela	1999
Lithuania	2009	Venezuela	2002
Malaysia	1998	Venezuela	2016