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Government Financial Assets and Debt Sustainability

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Abstract

Do government financial assets help improve public debt sustainability? To answer this question, we assemble a comprehensive dataset on government assets using multiple sources and covering 110 advanced and emerging market economies since the late 1980s. We then use this rich database to estimate the impact of assets on two key dimensions of debt sustainability: borrowing costs and the probability of debt distress. Government financial assets significantly reduce sovereign spreads and the probability of debt crises in emerging economies but not in advanced economies, and the effect varies with asset characteristics, notably liquidity. Government finacial assets also help discriminate countries across the distribution of sovereign spreads, thus signaling information about emerging economies' creditworthiness.

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CONTENTS **PAGE**

TABLES

FIGURES

I. INTRODUCTION

This paper analyzes the impact of government financial assets on two key dimensions of sovereign debt sustainability—borrowing costs and probability of debt distress.[2] Do assets help reduce borrowing costs and the likelihood of debt crises? If so, does the impact depend on assets characteristics (e.g., liquidity) and the sovereign's creditworthiness? Are some assets more useful for mitigating liquidity risks, and others for reducing solvency concerns? Although the importance of government assets for debt sustainability has been acknowledged by policymakers and practitioners (e.g., IMF (2011a, 2013, 2016a)), very little research has been done to answer these questions. This paper attempts to shed light on these issues, which are relevant not only for policymakers but also for debt and asset managers, debt sustainability analysts, and investors.

Why may government assets matter? Like international reserves, assets are a self-insurance device that facilitate shifting government income across time and states of nature. For instance, assets can serve as fiscal buffers to be used in times of distress to mitigate liquidity and solvency risks. These buffers can support the implementation of counter-cyclical fiscal policies during economic downturns, particularly in countries that are vulnerable to sharp fluctuations in commodity prices.

Assets can also work as a signaling device for developing economies. For instance, they can serve as collateral for creditors, and be used to signal responsible fiscal policies and hence establish good reputation and track record. In short, assets can improve market access conditions and reduce the likelihood of debt distress both in ex-ante and ex-post sense. However, markets will also internalize in their lending decisions some potential limitations of assets. Assets may not be available for immediate liquidation (e.g., for political reasons, or because they are encumbered to cover future liabilities); may not be properly valued (e.g., a non-traded loan whose market price is substantially lower than the book value); or may not be sufficiently liquid (e.g., some accounts receivable).

We rely on two different approaches to address the above questions. We use quantile regressions to investigate the *impact of government assets on the conditional distribution of sovereign bond spreads*. This allows to uncover the possibly differentiated effect of asset holdings across the distinct quantiles of sovereign risk, and hence whether assets may improve market access conditions through the borrowing cost channel. Second, we use binary response models to measure the *impact of government assets on the conditional*

[2] For brevity, we refer to 'government assets' or simply 'assets' throughout this paper. We focus on assets held by the fiscal authority or sovereign wealth funds but also control for the international reserves held by the central bank. We also use the convention that an "asset category" is a group of collection or asset instruments (e.g., assets held in debt instruments). An "asset instrument" corresponds to the statistical definition (GFSM 2014, ESA 2010, SNA 2008, PSDS 2013) of the underlying financial instrument in which the asset is held (e.g., loans, equity & shares). When there is no ambiguity, we may use the two terms interchangeably.

probability of debt distress. This allows to understand whether assets are relevant for mitigating the likelihood of debt distress and hence for reducing the large economic costs associated with crises.

We start our investigation by assembling a comprehensive database on assets from several data repositories inside and outside the IMF. This database includes detailed information by asset instruments from government balance sheets as well as aggregate time series, and covers 110 advanced and emerging economies going as far back as the late 1980s.

Second, we identify several stylized facts on the behavior of government assets at the cross-sectional (i.e., across asset instruments) and time series dimensions: advanced market economies (AMs) typically have larger assets holdings than emerging market economies (EMs); the cross-country distribution of assets is wide and skewed to the right; equity stakes are the largest asset instrument (almost half of total holdings); and assets behave pro-cyclically in EMs, that is, EMs tend to accumulate assets in good times and use them in times of distress to smooth the impact of market access loss and business cycle fluctuations.

Turning to the econometric analysis, the quantile regressions suggest that assets reduce sovereign borrowing costs in EMs, more so for countries with spreads at the top quantiles of the distribution of sovereign spreads. In addition, our probit regressions suggest that assets may significantly reduce the likelihood of debt distress in EMs, in some cases offsetting and even outweighing the impact of gross debt. These results broadly hold for all asset categories considered in this paper, including the more liquid ones. As expected, assets matter less for AMs, perhaps because market participants pay more attention to their stronger policies, institutions and macroeconomic fundamentals. In a nutshell, the results indicate that accumulating liquid assets may particularly benefit EMs that are perceived as riskier by investors. Our key findings survive several robustness checks and do not seem to be an artifact of the data or econometric specifications.

The paper provides several contributions to the existing literature. To our knowledge, we are the first to consider the role of distinct assets categories on borrowing costs and default probability. We also relax the assumption that gross debt and assets have the same (opposite) effect. While we expect effects with opposite sign, it is not clear that they should have the same magnitude, including because measured gross debt and assets may have different profiles (e.g., maturity, currency of denomination). Therefore, we allow for a potentially different impact of more granular asset categories on those two dimensions of debt sustainability. Different from previous studies that focus on either advanced (mostly OECD) economies or emerging markets, we use information on assets for the two groups and estimate the impact of assets across the spread distribution, without having to slice the data and induce unnecessary bias in our estimations. Moreover, we find that assets reduce risks to debt sustainability in EMs but less so in AMs, and that asset characteristics (notably liquidity) also matter.

The rest of the paper is organized as follows. Section II presents a brief literature review. Section III discusses our identification strategies. Section IV describes the data and identify stylized facts. Section V presents and discusses the results. Section VI suggests some practical implications. Section VII concludes.

II. LITERATURE REVIEW

Our work is related to two major strands of the empirical literature. First, to the strand on the determinants of sovereign bond spreads and market access. In this branch, most studies focus on the role of gross debt and typically find a positive correlation between gross debt and long-term interest rates or spreads. For instance, Edwards (1986), Eichengreen and Mody (2000), Borensztein and Panizza (2008), Gelos and Sandleris (2011), Comelli (2012), and Cruces and Trebesch (2013). More recent research has also found (for selected AMs and EMs) that countries with larger non-resident participation in local sovereign debt markets and larger participation of domestic investors tend to face lower borrowing costs even when debt levels are moderate to high (e.g., Arslanalp and Poghosyan (2014), Ebeke and Lu (2014), and Asonuma et al (2015)).

There is a handful of work in the first branch that attempts to uncover the role of assets on the behavior of interest rates (or spreads). However, they typically focus on net debt, implicitly assuming that gross debt and assets have similar impact (but with opposite sign) on borrowing costs. Probably because of data availability, these studies usually cover OECD countries, the Euro area, or another sub-set of advanced economies. For example, Ford and Laxton (1999), Conway and Orr (2003), Chinn and Frankel (2005), and Gruber and Kamin (2012), Ichiue and Shimizu (2015).

Noteworthy, Gruber and Kamin (2012) find a robust and significantly positive impact of net debt on long-term bond yields of OECD countries. Our work is close to but differs from Gruber and Kamin's in three relevant aspects. While they focus on OECD countries, use bond yields as dependent variable, and introduce net debt as a key control variable; we consider a large sample of both AMs and EMs, also investigate the likelihood of debt crisis as dependent variable, and allow assets and gross debt to have a distinct impact on our dependent variables.

Ichiue and Shimizu (2015) go one step further and explore the separate role of assets. They explain the behavior of government long-term forward rates for ten AMs using standard country fundamentals (e.g., inflation expectations, labor productivity growth, current account, foreign borrowing, primary balance, and demographics) as well net and gross debt. They find that net debt is relevant for explaining forward rates but assets are not. As we show in Section V, the latter is consistent with our own findings for AMs.

Hadzi-Vaskov and Ricci (2016) cover both AMs and EMs, with a special focus on the latter, and is the closest study to our paper. Like us, they allow for a distinct impact of gross debt and assets on spreads and find that both have significant effects on spreads but the effects roughly offset each other. Considering this evidence, they conclude that net debt is an appropriate measure for assessing the impact of indebtedness on spreads. Our results also show that net debt matters for sovereign spreads and the probability of default. But they also suggest that the effects of gross debt and assets may not necessarily offset each other depending on the asset category. For the more liquid assets, we find that assets have a larger impact than gross debt on spreads and the probability of default.

The second strand of the literature, to which our work is also related, focuses on the determinants of the probability of financial crises in developing and emerging economies. For instance, Manasse et al (2003), Kraay and Nehru (2006), Baldacci et al (2011), and Catão and Milesi-Ferretti (2014). To our knowledge, this strand of the literature has also paid little attention to the role of assets (beyond international reserves) in mitigating the likelihood of debt crises. These studies rely on early warning signal approaches or binary dependent models and typically find that larger levels of gross debt and international financial volatility lead to higher likelihood of crises in EMs. They also find that stronger fundamentals that are typically associated with better capacity to repay (e.g., adequate reserve coverage, robust growth, lower current account deficits) also reduce the probability of financial crises in EMs.

Our estimations control for the level of international reserves but do not specifically explore their role on debt sustainability or potential interactions with assets. However, our contribution to the literature in this regard is to show that over and beyond reserves, assets contain useful information for predicting the behavior of sovereign spreads and default probability. It is also worth noting that assets and reserves help achieve complementary goals, i.e. fiscal and external sustainability. Both are self-insurance instruments, and can serve as collateral and signaling devices, allowing countries to borrowing at lower rates, smooth rollover risks and be less prone to debt distress (e.g., Aizenman and Marion (2004), Jeanne et al (2011), Bianchi et al (2012), and Alfaro and Kanczuk (2013)).

III. METHODOLOGY

A. A Simple Economic Model

In this subsection, we briefly discuss the economic rationale guiding our identification strategy. To illustrate the two channels of interest, we assume that a sovereign issues one-period bonds that are bought by risk neutral international investors (see Edwards (1986) and followers, e.g., Comelli (2012)). The sovereign's borrowing cost is pinned down by the

lender's breakeven condition which depends on the opportunity cost of funds, i.e., the world risk-free rate R^*, and the sovereign's probability of default p:[3]

$$p_{it}(\theta R_{it}) + (1 - p_{it})R_{it} = R_t^*$$

where R is the sovereign's gross borrowing rate, and θ is the lender's recovery rate in default states (equivalently, $h \equiv 1-\theta$ is the lender's haircut). The spread over the risk-free rate is a non-linear and increasing function of the probability of default:

$$s_{it} = \frac{hp_{it}}{1-hp_{it}} R_t^* \quad (1)$$

The sovereign spread is also increasing in the haircut, consistent with the empirical evidence (e.g., Cruces and Trebesch (2013)). Following the tradition in the theoretical and empirical literature, we assume that the probability of default is a function of a vector X of country fundamentals that proxy for the sovereign's creditworthiness as well as global or push factors. We assume that the probability of default also depends on government assets A:[4]

$$p_{it} = p(A_{it}, X_{it}) \quad (2)$$

Equations (1) and (2) thus suggest two complementary ways for estimating the impact of assets on market access conditions. One can assess this impact on the country risk premium or the default probability or both as we do in this paper. We assume that the country spread is a linear function of assets and fundamentals and then move on to explore non-linearities through quantile regressions. Next, we assume the normal distribution for the default probability and estimate this last equation using a probit model.

B. Financial Assets and Sovereign Risk

To understand how assets affect sovereign spreads we estimate equation (3) below. We assume that $\Lambda' X_{\text{it}} = \Lambda_1 b_{\text{it}-1} + \Lambda'_2 Z_{it-1} + \Lambda_3 W_t$, where b is gross debt-to-GDP ratio, Z is a vector of country fundamentals and W is a vector of global factors.

$$spread_{it} = \alpha_i + \beta Assets_{it-1} + \Lambda' X_{it} + e_{it} \quad (3)$$

Following the empirical literature—e.g., Edwards (1986), Eichengreen and Moody (2000), Borensztein and Panizza (2008), Bellas et al (2010), Comelli (2012), Cruces and Trebesch (2013), and Catão and Milesi-Ferretti (2014)— Z includes real GDP growth, reserves-to-

[3] This simple setup assumes that from an individual lender's perspective the probability of default and the country's borrowing rate are given. In a somewhat similar environment, Neumeyer and Perri (2005) motivate country-specific and time-varying spreads by assuming that in each period there is a probability that the government will confiscate all debt service going from local borrowers to foreign lenders.

[4] In principle, equations (1) and (2) could be identified jointly or combined into a single equation. But as we explain in the next section, we preferred to estimate them separately using different techniques.

GDP ratio, current account balance-to-GDP ratio, inflation rate, and unexpected shocks to country credit ratings. The latter are proxied by the residuals of regressing credit ratings on macroeconomic fundamentals, the U.S. interest rate, and the country's history of debt default and restructurings (e.g., Cruces and Trebesch (2013)) which would indirectly reflect creditor losses. Lastly, in the baseline specifications W is given by the VIX which controls for changes in international investors' attitude towards risk. All domestic fundamentals are lagged to mitigate endogeneity and reverse causality problems.

The two key coefficients of interest from equation (3) are β (on assets) and Λ_1 (on gross debt). We expect Λ_1 to be positive as in the literature, and β to be negative. All else equal, we expect countries with higher debt-to-GDP and lower asset-to-GDP ratios—i.e., higher net debt—to face larger sovereign spreads and higher probability of debt distress. In other words, we expect that asset holdings mitigate the risk of debt distress and reduce borrowing costs.

Notice that we allow for a distinct impact of assets and gross debt on sovereign spreads. Alternatively, we could have estimated (3) by imposing the restriction that $\Lambda_1 = -\beta$. In that case, as in Gruber and Kamin (2012), only net debt—defined as gross debt net of financial assets— would be included in the regression. Our identification strategy is thus more flexible, and allows to test whether assets further help explain variations in sovereign spreads and in the default probability once debt is considered.

In this paper we are particularly interested in investigating whether assets matter for emerging economies, as these might use assets as a signaling device. Equation (4) augments specification (3) to include an emerging market (EM) categorical variable and an interaction term as follows:[5]

$$spread_{it} = \alpha_i + \beta Asset_{it-1} + \gamma Asset_{it-1}EM + \delta EM + \Lambda' X_{it} + e_{it} \quad (4)$$

Both specifications are estimated using panel data techniques (with fixed effects and clustered standard errors) and ordinary least squares. Due to the nature of the estimation strategy, the coefficients of interest, β and $\beta + \gamma$, reflect the marginal impact of assets at the mean of the sovereign spread distribution. But assets' marginal impact is likely to vary depending on the country's relative position in that distribution. Intuitively, a marginal increase in assets would matter more for riskier countries (say, those at the 90th percentile of the risk distribution) than for 'safer' countries (e.g., those at the median).

We thus investigate whether assets' marginal impact differs depending on the country's relative position in the sovereign spread distribution, i.e., whether the impact of assets on spreads is nonlinear. Specifically, we let the parameters of interest vary across the

[5] We interacted the EM dummy with gross debt but the estimated coefficient was statistically non-significant most of the time. This result also suggests that gross debt matters equally for both AMs and EMs, a fact considered by the Fund's debt sustainability frameworks.

conditional distribution of spreads. The analogous of equations (3) and (4) are estimated via *pooled quantile regression*. The model is specified as in equations (5) and (6), respectively:

$$Q_{Spread_{it}}(\tau) = \alpha(\tau) + \beta(\tau)Asset_{it-1} + \Lambda(\tau)'X_{it} \quad (5)$$

and

$$Q_{Spread_{it}}(\tau) = \alpha(\tau) + \beta(\tau)Asset_{it-1} + \gamma(\tau)(Asset_{it-1}EM) + \delta(\tau)EM + \Lambda(\tau)'X_{it} \quad (6)$$

Since quantile regressions measure the magnitude of the impact at various points of the risk-perception distribution, the above specifications allow to investigate whether government assets are particularly relevant for countries facing higher borrowing costs. The coefficients of interest in (5) and (6) are $\beta(\tau)$ and $\beta(\tau) + \gamma(\tau)$, respectively.

C. Financial Assets and Probability of Debt Distress

To estimate the impact of assets on the likelihood of debt distress we rely on the same controls used in the panel data and pooled quantile regressions. We use a *pooled probit* model to estimate the conditional probability of debt distress as specified in equations (7) and (8):

$$P(y = 1|Assets_{it,}\boldsymbol{X_{it}}) = \Phi(\alpha + \beta Assets_{it} + \Lambda' X_{it}) \quad (7)$$

and

$$P(y = 1|Assets_{it,}\boldsymbol{X_{it}}) = \Phi(\alpha + \beta Assets_{it} + \gamma(Assets_{it}EM) + \delta EM + \Lambda' X_{it}) \quad (8)$$

where $P(.)$ denotes probability of debt distress, and $\Phi(.)$ the standard normal CDF. In the event of debt distress the variable y takes the value of one (zero otherwise). The vector X_{it} is defined exactly as before. Like Catão and Milesi-Ferretti (2014), we use pooled data to prevent countries that never experienced a debt distress from being dropped from the sample thereby focusing on the cross-section dimension, and to mitigate the incidental parameter problem affecting fixed effects estimates.

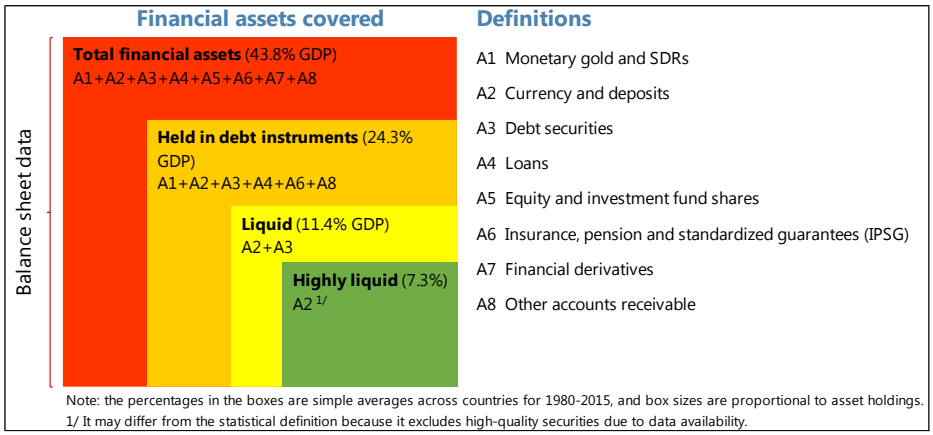
In our baseline definition of sovereign debt distress, a debt crisis is triggered by an outright default (either on domestic or external debt), a debt restructuring or a near-default situation proxied by IMF financing exceeding one hundred per cent of quota on a commitment basis. We impose the condition that a debt distress episode must not be preceded by another episode ending in any of the two previous years to avoid counting as single crises those episodes that are part of a longer spell of debt distress.

IV. DATA

A. Sample

Our sample comprises 110 market-access countries (30 AMs and 80 EMs), in line with the country coverage in the IMF's debt sustainability framework for market-access countries. We collect data on assets for this sample from several data sources inside and outside the IMF and all asset categories going back to the late 1980s. Figure 1 identifies the eight different financial asset instruments as defined in GFSM 2014 and included, as relevant, in governments' balance sheet data (see further details in the Appendix).

Figure 1. Description of Financial Asset Categories

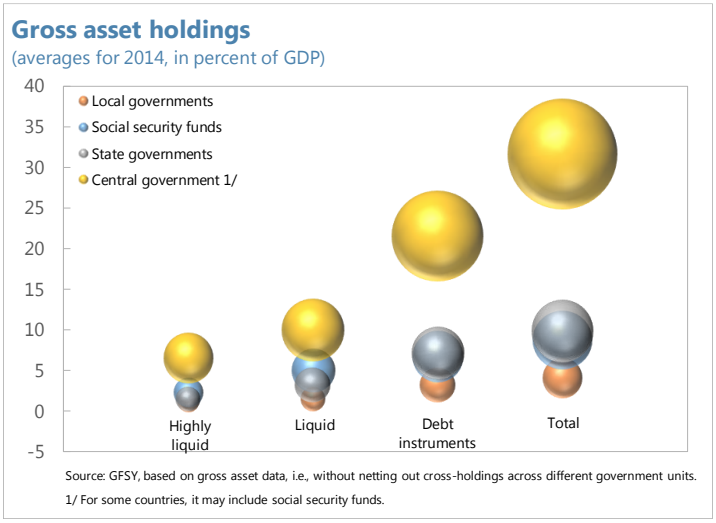


The categories from balance sheet data are presented in increasing order of liquidity. The most comprehensive (hence less liquid) asset category is *total financial assets*. It includes all financial assets reported in the balance sheet of the government. *Assets held in debt instruments* exclude equity and shares and financial derivatives, and is the asset counterpart of gross debt. The categories labeled *liquid* and *highly liquid* encompass currency & deposits plus debt securities, and only currency & deposits, respectively.[6]

The central government typically holds the bulk of each asset category, with the remainder held by regional governments and social security funds. The data does not allow to identify the holdings by sovereign wealth funds but for some countries presumably they would be accounted for at the central government level. Given data limitations and the fact that most assets are concentrated at the central government level (Figure 2), we do not control for institutional holdings in our regressions. Also, we could not control for asset availability across government units, for instance, encumbered assets held by social security or sovereign wealth funds may not be immediately available even when very liquid.

[6] For a statistical definition of some of the concepts used in this paper—e.g., gross debt, net debt, and debt net of highly liquid assets, please see GFSM 2014 (Chapter 4—annex, and Chapter 7—paragraph 7.243).

Figure 2. Asset Holdings Across Government Units and Asset Instruments



Data for constructing these asset categories are obtained from OECD, Eurostat and the IMF's Government Finance Statistics Yearbook (GFSY) databases. For each country, we use the available data with the longest time coverage. Assets are typically held by the general or central government and mentioned above, and exclude international reserves at the central bank and non-financial assets such as buildings and land.[7] Assets may be held domestically or abroad (e.g., through sovereign wealth funds) and denominated in domestic or foreign currency, however these are lumped together in the data available. Data limitations also prevented us to control for the share of non-resident holdings of debt or assets in our regressions. Having information on the profile of asset holdings would be important not only from the analytical point of view (e.g., it would provide a better understanding of domestic versus external borrowing costs) but also in terms of risk assessment and policy advice (e.g., to tailor external debt issuances based on the availability of external assets that could be used as a hedge instrument).

We also collected data on assets from the IMF's WEO as reported by IMF country desks, and data on government deposits as measured by monetary surveys and reported to the IMF's International Financial Statistics.[8] Following the literature and to avoid loss of observations (for instance, by taking first differences), we use debt and assets as ratios to nominal GDP.

[7] Section II provided an overview of overlapping issues with international reserves. For a discussion on non-financial assets please refer to Bova et al (2013). We do not cover non-financial assets in this paper because of data limitations and because these assets are probably less useful for materially improving debt sustainability (e.g., they are illiquid, cannot be liquidated/sold at short notice, and are difficult to value).

[8] While the data from monetary surveys has better time coverage than data from balance sheets, reporting standards were not uniform until 2001 thus constraining time series analysis and cross-country comparisons. More information about this dataset and related results are available upon request.

Panel-data unit-root tests suggest that assets and gross debt (as ratios of GDP) are stationary in our sample. The Appendix describe in details the data sources, coverage, and the asset categories used in the estimations.

Sovereign spreads are measured by JP Morgan EMBI spreads, complemented with data on long-term spreads from other sources. For non-EMBI countries, spreads are the difference of long-term bond yields with respect to the corresponding bond yield in the United States (for non-European countries), or Germany (for European countries).

Data on the signals of distress come from IMF staff and several other sources, including Reinhart and Rogoff (2011) (domestic defaults), Das et al (2012b) (restructuring of debt held by official creditors), Cruces and Trebesch (2013) (restructuring of debt held by private foreign creditors) and Catão and Milesi-Ferretti (2014) (external defaults).

The selection of the control variables for the quantile and probit regressions was based on a literature survey about the determinants of sovereign bond spreads and likelihood of debt crises (Table A 2). Table A 1 shows an overview of controls included in similar studies.

B. Descriptive Statistics

Table 1 shows descriptive statistics for net debt and the five country-specific controls used in the baseline specifications. While EMs have lower asset holdings than AMs (see Table 2), they also tend to carry substantially lower gross debt which typically implies lower net debt as well. EMs tend to hold larger international reserves and grow faster than AMs, while their other fundamentals (current account balance, inflation and creditworthiness) tend to perform worse.

Table 1. Net Debt and Baseline Controls: Descriptive Statistics, 1980–2015

Variable	Net debt/GDP based on												Gross debt/GDP		
	Total assets			Assets in debt instruments			Liquid assets			Highly liquid assets					
	AM	EM	All	AM	EM	All	AM	EM	All	AM	EM	All	AM	EM	All
Obs	543	291	834	540	296	836	540	291	831	540	290	830	1043	2482	3525
Mean	18.0	2.4	12.6	37.4	20.5	31.4	52.0	31.0	44.6	57.5	32.0	48.6	60.0	49.6	52.7
Median	27.6	3.6	18.1	40.7	18.7	33.0	52.1	29.6	41.9	55.0	30.1	45.2	54.8	40.6	44.4

Variable	Real GDP growth			CAB/GDP			Reserves/GDP			Inflation			Credit ratings		
	AM	EM	All	AM	EM	All	AM	EM	All	AM	EM	All	AM	EM	All
Obs	1048	2601	3649	970	2470	3440	1038	2437	3475	1043	2546	3589	1019	2439	3458
Mean	2.7	3.8	3.5	0.2	-1.2	-0.8	13.9	17.6	16.5	5.6	38.0	28.5	77.9	40.9	51.8
Median	2.6	3.9	3.5	-0.5	-2.3	-1.7	7.0	12.6	11.2	2.6	6.0	4.5	82.6	39.4	51.0

The database has more observations on assets for AMs, despite the larger number of EMs in the sample (Table 2). But in both groups, mean asset holdings exceed the median (the asset distribution is skewed to the right). There is also a wide disparity in asset holdings across countries with a few countries (mostly commodity exporters) having the largest asset positions. To illustrate, the asset portfolio of the top asset holder in the sample (Norway) is about ten times larger than the sample mean.

Table 2. Asset Holdings by Category and Country Group, 1980–2015 (Percent of GDP)

Variable	Total			In debt instruments			Liquid			Highly liquid		
	AM	EM	All	AM	EM	All	AM	EM	All	AM	EM	All
Obs	543	291	834	540	296	836	540	291	831	540	290	830
Mean	47.4	37.1	43.8	27.2	19.1	24.3	12.6	8.6	11.2	7.1	7.6	7.3
Median	37.4	32.8	36.4	20.7	16.0	19.4	8.2	7.3	7.9	5.1	6.4	5.6

In terms of size, the largest asset instruments are equity and shares, followed by accounts receivable, and currency and deposits. Roughly similar pattern is observed in both AMs and EMs (Table 3).

Table 3. Asset Holdings by Category and Instrument (Percent of GDP)

Asset category and instrument	Median 1980-2015	
	AMs	EMs
By category		
Total	47.4	37.1
Held in debt instruments	27.2	19.1
Liquid financial assets	12.6	8.6
Highly liquid	7.1	7.6
By instrument		
A1 Monetary gold & SDRs	0.05	0.03
A2 Currency & deposits	7.1	7.6
A3 Debt securities	5.6	1.1
A4 Loans	7.1	4.6
A5 Equity & investment fund shares	19.7	17.6
A6 Insurance, pension, & standardized guarantee schemes	0.11	0.01
A7 Financial derivatives	0.1	0.1
A8 Other accounts receivable	7.4	7.2

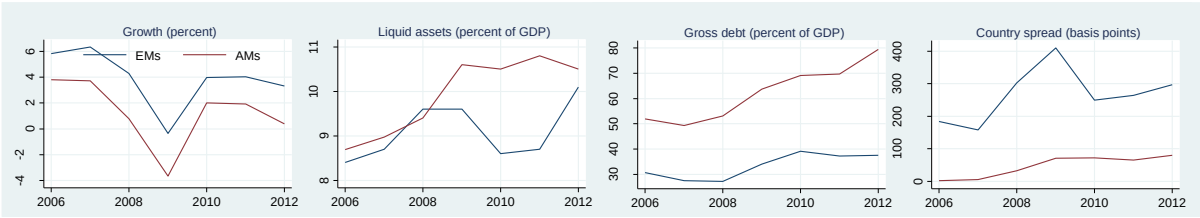
Assets and gross debt tend to be countercyclical in AMs and roughly acyclical in EMs in the overall sample, whereas spreads are clearly countercyclical in both groups (see correlations with growth in Table 4, first two blocks). This correlation is robust to the way assets and gross debt are measured, i.e., in levels or first differences. The correlation between spreads and gross debt also has the expected positive sign in EMs.

Table 4. Pairwise Correlations, 1980–2015

Variable	Asset category				International reserves	Gross debt	Spread	Growth
	Total	Debt	Liquid	Highly liquid				
Asset category	**Advanced economies--assets, reserves and gross debt in levels (percent of GDP)**							
Total	1.00							
In debt instruments	0.92	1.00						
Liquid	0.90	0.94	1.00					
Highly Liquid	0.29	0.48	0.58	1.00				
International reserves	0.16	0.20	0.20	0.30	1.00			
Gross debt	-0.11	-0.04	-0.07	-0.03	0.03	1.00		
Spread	-0.07	-0.10	-0.06	0.06	-0.19	-0.12	1.00	
Growth	-0.09	-0.14	-0.15	-0.21	0.19	-0.18	-0.12	1.00
Asset category	**Emerging economies--assets, reserves and gross debt in levels (percent of GDP)**							
Total	1.00							
In debt instruments	0.71	1.00						
Liquid	0.21	0.50	1.00					
Highly Liquid	0.16	0.43	0.86	1.00				
International reserves	-0.06	0.12	0.28	0.40	1.00			
Gross debt	0.08	-0.03	-0.03	0.09	-0.04	1.00		
Spread	-0.12	-0.19	-0.19	-0.21	-0.14	0.24	1.00	
Growth	-0.11	-0.04	0.04	0.02	-0.05	-0.04	-0.18	1.00
Asset category	**Advanced economies--assets, reserves and gross debt in first differences (percent of GDP)**							
Total	1.00							
In debt instruments	0.69	1.00						
Liquid	0.47	0.72	1.00					
Highly Liquid	0.24	0.45	0.58	1.00				
International reserves	0.10	0.11	0.13	0.17	1.00			
Gross debt	0.19	0.30	0.18	0.17	0.09	1.00		
Spread	0.17	0.14	0.11	0.09	0.00	0.13	1.00	
Growth	-0.10	-0.08	-0.08	-0.09	-0.14	-0.41	-0.12	1.00
Asset category	**Emerging economies--assets, reserves and gross debt in first differences (percent of GDP)**							
Total	1.00							
In debt instruments	0.76	1.00						
Liquid	0.51	0.77	1.00					
Highly Liquid	0.44	0.67	0.89	1.00				
International reserves	-0.11	-0.02	0.13	0.19	1.00			
Gross debt	0.30	0.28	0.14	0.17	0.10	1.00		
Spread	0.13	0.09	0.04	0.06	0.02	0.02	1.00	
Growth	-0.02	-0.08	0.01	-0.02	-0.34	-0.35	-0.18	1.00

The apparent acyclicality of assets in EMs is somewhat puzzling. However, since the Global Financial Crisis (GFC) assets look procyclical and gross debt countercyclical (Figure 3, based on a balanced sample). The correlation between assets and growth also tends to be positive in the years immediately before debt distress episodes (see Figure 5 below). In any case, the unconditional correlations in Table 4 and Figure 3 and Figure 5 are just a first look at the data. In Section V below we estimate the conditional correlations of interest, properly controlling for country-specific and common factors.

Figure 3. Growth, Assets, Debt and Spreads during the GFC (Median)



Many EMs like Chile, Russia, and Gulf countries used part of their assets accumulated prior to the crisis to support counter-cyclical fiscal spending during and/or after the crisis. For instance, Russia drew down from its Reserve Fund to implement vigorous countercyclical fiscal stimulus, and liquidity injections to cover large unhedged foreign exchange positions by the private sector (IMF (2010)). Saudi Arabia used government deposits at the central bank and also new borrowing to finance government spending. Immediately after the crisis, some oil-producing countries like Kuwait, Oman, Bahrain and Qatar used their oil revenues gains (boosted by recovering oil prices after 2009) to fund increases in non-oil deficits rather than building buffers (e.g., IMF (2011b)). In AMs, bailouts of banks and non-financial corporations during the GFC—in many cases funded by accumulation of gross debt—expanded both sides of the government balance sheet (e.g., TALF, TARP, AMLF, Maiden Lane programs in the United States).

The value of some assets owned by commodity-intensive producers is likely to be pro-cyclical, i.e., it increases in good times when commodity prices are up and declines during crises when commodity prices go down. Figure 4 illustrates that the market value of commodity-producing companies that are partially or fully controlled by the government is highly correlated with commodity price fluctuations. This highlights the exposure of commodity exporters' wealth to commodity price cycles, a risk that many countries find very difficult to diversify away.[9]

Figure 4. Commodity Prices and Equity Value of Commodity-Producing Firms

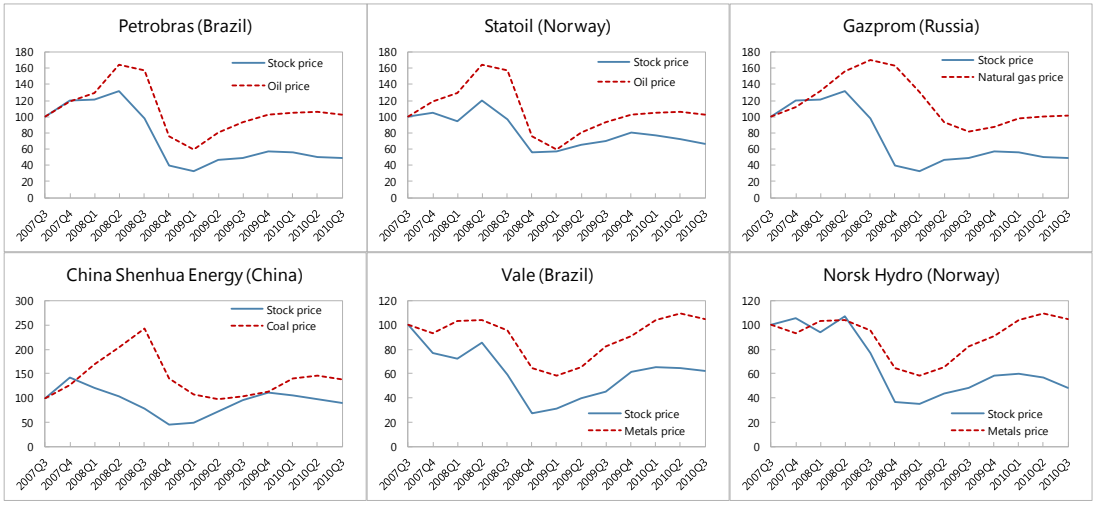


Table 5 shows that crises are rare events in AMs, with most episodes identified in the sample occurring in EMs. The average duration of a crisis in EMs is 5 years. As documented in the literature (e.g., Cruces and Trebesch (2013), and Catão and Milesi-Ferretti (2014)), our

[9] The asset price dynamics shown in Figure 4 is not fully reflected in the balance sheet data, including because equity is typically recorded at historical value.

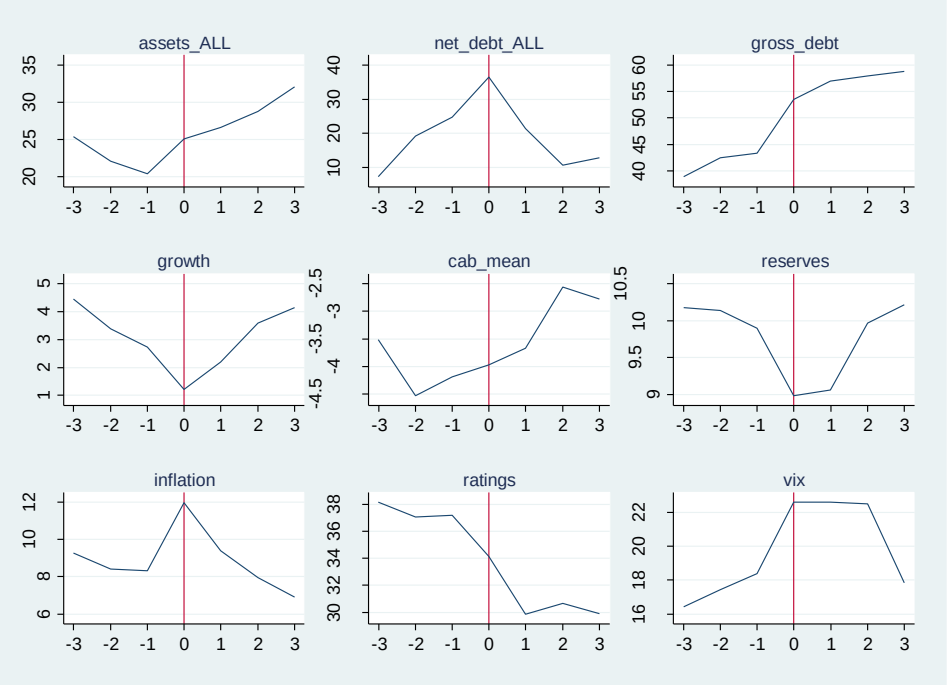
definition of debt distress also implies that sovereign debt crises tend to cluster over time, reflecting changes in global economic and financial conditions, like the events that triggered the debt crisis of the 1980s, and the debt difficulties associated with the recent GFC.

Table 5. Triggers of Debt Crises in AMs and EMs, 1980–2015

Triggering signal	Baseline definition		
	AMs	EMs	All
Outright defaults (domestic or external)	0	28	28
Restructurings (official and commercial debt)	1	18	19
Financing needs (IMF financing)	7	48	55
Some combination of the above	1	18	19
All	**9**	**112**	**121**
Average duration in years	**3**	**5**	**5**

Assets, debt and the relevant macro variables tend to display the expected behavior around the crises identified in the sample (Figure 5). Assets typically decline prior to the crisis in a procyclical fashion and are rebuilt thereafter, probably reflecting fiscal adjustment to cope with the crisis. Gross debt increases sharply over the crisis, from about 40 percent of GDP to more than 60 percent of GDP. All relevant macro variables deteriorate in the run up to the crisis but tend to show some recovery a few years later. Countries also experience tighter global financial conditions (as measured by the VIX) at the onset of a crisis.

Figure 5. Dynamics Around Debt Distress Episodes in EMs (Median)



V. RESULTS

A. Financial Assets and Sovereign Spreads

Table 6 reports the results for the fixed effects panel regressions estimated via ordinary least squares (OLS).[10] Results for specifications 3 and 4 are shown in the last two columns of each block. All coefficients on the macro fundamentals have the expected sign and nearly all are statistically significant at conventional significance levels. But the impact of assets on spreads across the four categories is less systematic, for instance compared with international reserves. Only the two broader categories (total assets and assets held in debt instruments) add information to the regressions when controlling for country fixed effects and macro fundamentals, and only for specification (3). An F-test for the joint impact of gross debt and assets on spreads suggests that this impact is not statistically different from zero, as in with Hadzi-Vaskov and Ricci (2016).

Table 6. Panel OLS Fixed Effect Regressions (Dep. Variable: Bond Spreads, in bps)

Controls	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs
	Total assets				Assets held in debt instruments			
Debt/GDP, lagged (Λ_1)	2.302***	1.434	2.480***	2.489***	2.200***	2.270***	2.466***	2.426***
Assets/GDP, lagged (β)			-0.730	-0.166			-1.455	-0.199
Assets/GDP x EM, lagged (γ)				-2.994***				-4.809***
Real GDP growth, lagged	-13.68***	-15.25***	-13.91***	-12.91***	-13.03***	-13.67***	-13.25***	-12.43***
CAB/GDP (3 year avg.), lagged	-8.191**	-6.308	-7.699**	-7.941**	-8.552**	-7.684**	-8.153**	-8.442**
Reserves/GDP, lagged	-2.421**	-2.731***	-2.417***	-2.576***	-2.788***	-2.704***	-2.667***	-2.727***
Inflation rate, lagged	14.56***	14.95***	14.92***	16.20***	9.425**	9.813**	9.713**	10.39**
Country credit ratings, lagged	-5.775***	-7.034***	-5.776***	-6.244***	-6.282***	-6.610***	-6.255***	-6.571***
VIX	3.075***	2.711***	3.034***	3.142***	3.718***	3.628***	3.713***	3.784***
Constant	52.18	199.7***	73.66	81.27	76.12	133.3***	93.67*	94.18*
Observations	725	725	725	725	725	725	725	725
R-squared	0.346	0.339	0.350	0.361	0.322	0.324	0.326	0.334
Number of countries	52	52	52	52	52	52	52	52
F-test for H_0: $\Lambda_1 + \beta + \gamma = 0$			4.81**	0.612			0.741	2.727
	Liquid assets				Highly liquid assets			
Debt/GDP, lagged (Λ_1)	2.240***	2.150**	2.305***	2.349***	2.240***	2.142**	2.161**	2.160**
Assets/GDP, lagged (β)			-0.598	0.0214			1.406	1.299
Assets/GDP x EM, lagged (γ)				-4.073				0.474
Real GDP growth, lagged	-13.72***	-14.59***	-13.88***	-13.74***	-13.72***	-14.07***	-13.62***	-13.62***
CAB/GDP (3 year avg.), lagged	-8.197**	-7.496*	-8.066**	-8.349**	-8.197**	-8.133**	-8.135**	-8.131**
Reserves/GDP, lagged	-2.476***	-2.269**	-2.390**	-2.235**	-2.476***	-2.261**	-2.661**	-2.671**
Inflation rate, lagged	14.46***	14.21***	14.42***	14.15***	14.46***	14.28***	14.54***	14.56***
Country credit ratings, lagged	-5.876***	-5.955***	-5.801***	-5.562***	-5.876***	-6.114***	-5.875***	-5.895***
VIX	3.100***	3.092***	3.118***	3.118***	3.100***	3.089***	3.074***	3.073***
Constant	60.44	92.01	61.40	57.78	60.10	83.88	57.03	57.10
Observations	720	720	720	720	719	719	719	719
R-squared	0.346	0.344	0.346	0.349	0.346	0.343	0.347	0.347
Number of countries	52	52	52	52	51	51	51	51
F-test for H_0: $\Lambda_1 + \beta + \gamma = 0$			2.034	0.169			2.86*	0.594

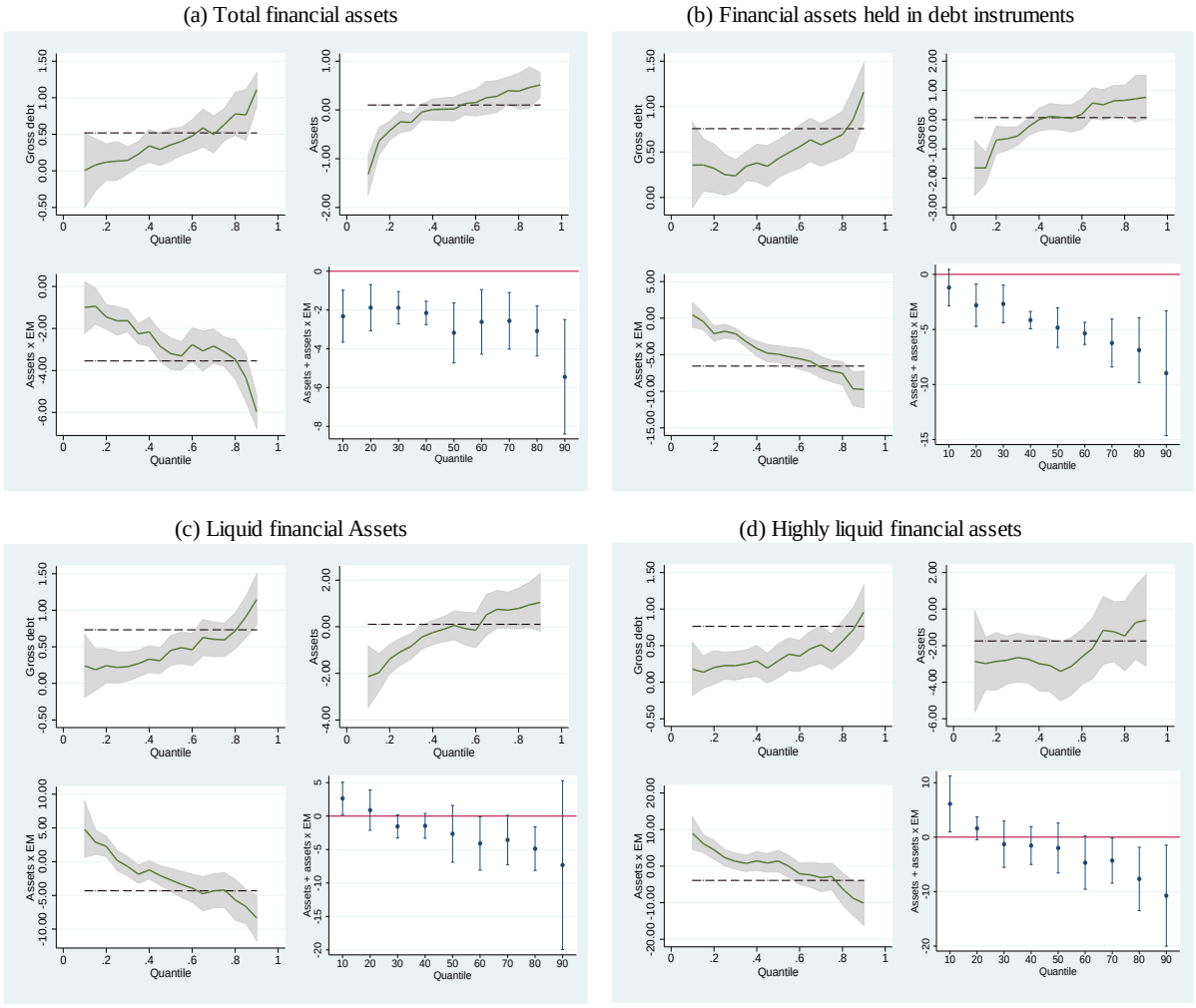
***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

Next, we estimate pooled quantile regressions (specifications 5 and 6). Figure 6 below and Figure A 2 to Figure A 5 in the appendix summarize the key results, where confidence bands describe the quantile coefficients and dotted lines the OLS analogues. The latter only capture the average impact of each variable on spreads thus missing the marked nonlinearities synthetized by the quantile coefficients. Most estimated coefficients have the expected sign

[10] Given data availability, we are not able to fix the sample size across the specifications shown in this paper.

and are statistically significant across quantiles and asset categories. Note that sovereign spreads tend to react more strongly to growth, inflation and credit ratings in countries that investors perceive as riskier (Figure A 2 to Figure A 5).

Figure 6. Marginal Effects on Spreads (left to right): $\Lambda_1(\tau)$, $\beta(\tau)$, $\gamma(\tau)$, $\beta(\tau)+\gamma(\tau)$



Do gross debt and assets behave in the same fashion? This can be seen in Figure 6 which presents the results for gross debt ($\Lambda_1(\tau)$) and assets($\beta(\tau)$, $\gamma(\tau)$, and $\beta(\tau)+\gamma(\tau)$). Consistent with the OLS results in Table 6, the response of spreads to gross debt is positive and increasing in country risk, as expected. The marginal impact of assets on spreads, $\beta(\tau)$, is either zero or around the OLS average in the case of advanced economies. This result can be interpreted in several ways. First, the signaling role of assets is probably less relevant for AMs as a group than for EMs, given their stronger institutions, policies, and capacity to repay. Second, assets should matter even less for countries with reserve or quasi-reserve currencies, which comprise about half of the AM sample if all euro area countries are considered. Third, as pointed out by Hadzi-Vaskov and Ricci (2016), the interest rates (hence spreads) that matter for AMs are in local currency, which reduces exposure to the "original

sin" and the need for holding buffers against market distress.[11] Finally, more efficient debt and cash management and budget execution may also weaken the correlation between assets and borrowing costs in AMs.

Turning to EMs, the figure shows that the sensitivity of spreads to assets ($\beta(\tau)+\gamma(\tau)$) is typically larger and statistically significant for countries at higher quantiles of risk and across all asset categories. Different from AMs, assets seem to be particularly useful for facilitating market access for the riskiest emerging economies. Hadzi-Vaskov and Ricci (2016) also find that sovereign spreads become more responsive to asset positions in high-spread countries facing market stress. However, since they rely on panel OLS regressions, they could not explore the spread variation across the entire distribution as we do.

Worth highlighting, a 10-percentage point (pp) increase in assets by an EM at the 90th percentile of risk would reduce sovereign spreads by 60–100bps, compared to 0-50bps for a country around the median of the distribution. In principle, this strategy could be financed by issuing gross debt because the joint impact of debt and assets is typically negative and significant at higher quantiles of risk (results available upon request).

The evidence thus far confirms our prior that government assets, including the more liquid ones, reduce debt sustainability risks. Very liquid assets are better suited for mitigating macroeconomic shocks, including to risk-premia, exchange rates, and commodity prices. In many EMs with constrained access to hedging instruments and where domestic debt markets are not a viable source of financing, more liquid assets can be deployed against liquidity pressures and debt service difficulties. These assets may also be less subject to maturity mismatches, more readily available and priced by investors more easily.

In theory, governments cannot borrow boundlessly or run Ponzi schemes. But in practice could governments increase their liquid asset buffers through debt accumulation and still benefit from lower borrowing costs? Well-targeted asset-liability management strategies can conceivably reduce borrowing costs even if the level of net debt remains unchanged (see Das et al (2012a) for a detailed discussion on sovereign liability and asset management practices). For instance, a government could borrow long term to improve its debt profile (i.e., increase the average maturity of its gross debt) or buy precautionary liquid buffers to meet financing needs in the near and medium term. While net debt remains the same under the two strategies, they still could reduce average borrowing costs if investors' perceptions and market conditions prevailing at the time of the new borrowing are favorable enough.

However, it is difficult to imagine a situation where governments could systematically explore an asset-financed-by debt strategy. For instance, if the average interest rate on newly

[11] On the original sin, see Hausmann and Panizza (2003), and Eichengreen et al (2007).

issued debt exceeds the average return on the assets purchased, as suggested by theory and historical experience, the strategy could lead to significant deterioration of the fiscal balance. This situation would particularly apply to EMs purchasing low-risk low-return assets and issuing debt at substantial risk premia. The fiscal and quasi-fiscal costs associated with international reserves accumulation in many EMs also illustrate this tradeoff.[12]

B. Robustness of the Results for Sovereign Spreads

We run alternative specifications replacing VIX with measures of international risk-free rates, term-premia, and US corporate high yield as in Cruces and Trebesch (2013), but none dominated the baseline. We also controlled for the country's track record of default and debt restructuring but this variable was typically not statistically significant and often had the wrong sign. This counterintuitive result may in part be explained by the availability of asset data which constrains the use of all information on past defaults and restructurings in the regression sample.

To mitigate this problem and test whether our results hold over a longer sample period, we estimate equations (4) and (6) using information on assets from the WEO database. The results based on the OLS regressions show that assets in EMs have the expected sign and are statistically significant (Table A 6). In line with the test results showed in Table 6 and with the findings of Hadzi-Vaskov and Ricci (2016), the joint impact of gross debt and assets on sovereign spreads is not statistically different from zero. But default history does not seem to matter, after controlling for assets and macro fundamentals. The results for the quantile regressions are similar to the baseline findings for the other asset categories, i.e., the marginal impact of assets on spreads is around zero for AMs but tend to be significant and increasing with risk for EMs (Figure A 6).

Next, we further control for the state of business cycles by also including the output gap (measured by the Hodrick-Prescott filter) but keeping GDP growth in the baseline specifications. The coefficient on the output gap is statistically significant in most quantiles of the distribution of sovereign spreads, but it typically comes with a positive sign. Mechanically, a positive sign may be reflecting the fact that countries tend to be expanding fast in the run up to a crisis, with the trough of the cycle typically occurring one year into the crisis (Figure A 10). Economically, a large positive output gap may be signaling growing vulnerabilities (e.g., an overheated economy driven by fiscal expansion) rather than a healthy economic expansion. In any case, the addition of output gap does not undermine GDP growth

[12] In practice, even countries with large negative net debt would face non-negligible borrowing costs. To illustrate, in the last quarter of 2016, Saudi Arabia raised $17.5 billion in the largest bond sale by an EM to date paying 135-210bps above equivalent maturity U.S. bond yields, a benchmark safe asset. Note that while EM borrowing costs would typically exceed the risk-free rate, governments may still be able to invest in assets with potentially higher risk-adjusted returns in the short run.

nor assets. In fact, the marginal impact of assets on spreads has the same order of magnitude as in the baseline and its variance is somewhat lower (Figure A 7).

We also re-estimate the baseline model using observations up to 2007 to test whether the sharp increase in risk premium during the Global Financial Crisis is affecting the results. The findings still hold for assets held in debt instruments and highly liquid forms at the top quantiles of the spread distribution (Figure A 8). However, this conclusion should be interpreted with caution because it is based on a substantially reduced number of observations.

Finally, we estimate equation (6) using Hadzi-Vaskov and Ricci (2016)'s parsimonious model (HVR specification). Their baseline specification is more parsimonious than ours. Besides gross debt and assets, it only includes growth, inflation, VIX and U.S. interest rate. In this exercise, we use asset data from WEO as they do. The results show the importance of accounting for non-linearities. Under HVR specification, gross debt seems to matter only at higher quantiles of risk while assets matter across the entire distribution for EMs (Figure A 9), as in Figure A 6. Interestingly, the dispersion around the marginal impact on spreads for EMs (last panel of Figure A 6) is smaller than in the baseline, including because of the larger number of observations available for the HVR specification.

C. Financial Assets and Probability of Debt Distress

Table 7 shows the results for the probit regressions. Most drivers of the probability of debt distress consistently have the expected sign and are statistically significant. In line with the findings of the literature, gross debt is a key determinant of the likelihood of debt crisis across all specifications and asset categories.

Like in the panel OLS regressions, the coefficient on net debt (second column in each block of Table 7) has the same order of magnitude of that on gross debt. This would imply that the order of magnitude of the coefficients on gross debt and assets would be also similar (but with opposite sign). But a z-test for the joint impact of debt and assets reveals that this conjecture only holds for total assets and assets held in debt instruments. Thus, the more liquid asset categories seem to exert a disproportionately larger impact than gross debt on the probability of debt distress in the two empirical models (equations 7 and 8).

Like the panel OLS and quantile regressions, the coefficient on assets alone in the full specification (last column of each block of Table 7) is not statistically significant. This means that assets do not seem to be an important determinant of the probability of debt distress in AMs. Therefore, the results suggest that EMs may benefit more from asset holdings than AMs. This benefit may be particularly stronger for EMs with limited or no access to international capital markets, or that are more likely to experience disruption of market access during times of stress.

Table 7. Pooled Probit (Dependent Variable: Probability of Debt Distress)

Controls	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs
	Total assets				Assets held in debt instruments			
Debt/GDP, lagged	2.125***	1.656**	2.371***	2.881***	1.767***	1.842**	1.825**	2.274**
Assets/GDP, lagged			-0.945	1.789			-1.982	0.560
Assets/GDP x EM, lagged				-3.188*				-3.707
EM dummy				2.421***				1.922**
Real GDP growth, lagged	-7.243	-8.609	-7.100	-7.254	-8.370*	-8.478*	-8.525*	-8.777**
CAB/GDP (3 year avg.), lagged	-18.33***	-18.80***	-19.56***	-24.44***	-16.05***	-15.87***	-15.86***	-19.87***
Reserves/GDP, lagged	-5.074***	-4.419***	-4.785***	-8.405***	-3.403*	-2.385	-2.314	-4.767*
Inflation rate, lagged	1.635	5.452**	3.808	3.533	-0.227	-0.0813	-0.0786	-1.187
Country credit ratings, lagged	-5.286***	-4.253***	-5.375***	-4.257***	-4.057***	-3.726***	-3.678***	-2.261
VIX	8.961**	6.155***	8.262**	7.148**	7.907**	7.816**	7.759**	6.686**
Constant	-5.481***	-4.273***	-5.370***	-7.085***	-4.942***	-4.776***	-4.737***	-5.964***
Observations	712	712	712	712	714	714	714	714
Pseudo R-squared	0.476	0.471	0.486	0.524	0.437	0.447	0.447	0.484
Marginal effect of assets				-0.029				-0.075
Marginal effect of debt & assets			0.033	0.031			-0.004	-0.021
	Liquid assets				Highly liquid assets			
Debt/GDP, lagged	2.299***	2.582***	2.534**	2.949**	2.367***	2.631***	2.779***	3.195***
Assets/GDP, lagged			-13.13***	-2.465			-12.35**	0.156
Assets/GDP x EM, lagged				-15.45**				-20.92**
EM dummy				1.998**				2.344**
Real GDP growth, lagged	-7.045	-6.951	-9.297*	-8.047	-6.941	-6.740	-7.589	-6.356
CAB/GDP (3 year avg.), lagged	-19.77***	-20.01***	-20.46***	-22.02***	-20.36***	-20.73***	-21.25***	-23.06***
Reserves/GDP, lagged	-4.862**	-4.099**	-1.006	-3.745	-5.348**	-4.632**	-1.942	-5.491*
Inflation rate, lagged	1.521	1.432	1.312	0.227	1.701	1.672	1.626	0.478
Country credit ratings, lagged	-5.626***	-5.708***	-4.672***	-3.544**	-5.984***	-6.088***	-5.457***	-4.280***
VIX	8.269**	8.703**	8.361**	8.220**	8.122**	8.418**	7.944**	7.853**
Constant	-5.508***	-5.707***	-5.316***	-6.667***	-5.496***	-5.676***	-5.443***	-6.892***
Observations	709	709	709	709	708	708	708	708
Pseudo R-squared	0.492	0.506	0.528	0.549	0.501	0.513	0.529	0.555
Marginal effect of assets				-0.387**				-0.448**
Marginal effect of debt & assets			-0.24**	-0.323**			-0.218**	-0.379**

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

The impact of liquid and highly liquid assets on the probability of debt distress is also economically significant: ceteris paribus and keeping all controls at the mean, a 10-percentage point increase in both gross debt and assets would reduce the crisis probability by 2-4 pp depending on the specification. This is compelling evidence that asset liquidity matters and ignoring it in debt sustainability analyses could lead to incorrect assessments about the likelihood of debt crises in emerging economies. By lowering the probability of debt distress, these assets would indirectly help reduce the related and typically large economic costs of default.

D. Liquidity versus Solvency

Is it the case that liquid assets are more useful for mitigating liquidity risks with other assets (perhaps less liquid) more useful for reducing long-term solvency concerns? While acknowledging the inherent difficulty with identifying liquidity and solvency crises, we change our baseline definition of debt distress to proxy for these two dimensions.

We associate liquidity crises with episodes that do not involve defaults or deep debt restructurings. More specifically, we identify these episodes with "light" restructurings (i.e., no face value reduction and NPV haircuts below the sample median), large spikes in bond spreads (i.e., levels above 1000bps or deviations larger than two standard deviations above historical mean, in line with Pescatori and Sy (2007)), and large IMF programs (above 100

percent of quota). We also require that any of these signals do not coincide with deep debt treatments in the current and next three years. These criteria allow to identify 156 liquidity episodes, of which 123 in EMs.

We proxy solvency crises with events signaling "deep" debt treatments: outright defaults on domestic or external debt, Paris Club restructurings involving face value reduction, and restructuring of commercial debt involving face value reduction and/or NPV haircuts above the sample median.[13] These criteria allow to identify 67 episodes, of which 65 in EMs.

Table 8 shows the results for the most liquid and for the broadest (thus less liquid) asset categories. The marginal effect of assets is not strong, but the statistical significance of the coefficients on assets suggests that highly liquid assets have a larger correlation with liquidity crises than total assets, and vice-versa for solvency crises. Intuitively, assets that can be liquidated quickly should be the most useful for smoothing the impact of sudden market pressures or rollover difficulties, whereas assets that are not immediately liquid could still help address solvency risks over the medium and long term.

Table 8. Pooled Probit (Dep. Variable: Probability of Liquidity and Solvency Crises)

Controls	Total assets	Highly liquid assets	Total assets	Highly liquid assets
	Liquidity crises		Solvency crises	
Debt/GDP, lagged	0.0577	0.150	2.123**	1.599
Assets/GDP, lagged	0.323	3.567	-9.816***	-20.62
Assets/GDP x EM, lagged	0.430	-7.613*	7.778*	19.63
EM dummy	-0.274	0.574	-1.627	-0.519
Real GDP growth, lagged	-7.165***	-7.038***	-19.06***	-17.06***
CAB/GDP (3 year avg.), lagged	-4.177	-4.075	-5.087*	-2.740
Reserves/GDP, lagged	-2.839***	-2.769**	-3.351	-4.230
Inflation rate, lagged	1.728	1.888	3.293	0.469
Country credit ratings, lagged	-2.616***	-2.233***	-3.170**	-3.505**
VIX	4.161**	3.295**	3.346	5.823
Constant	-2.415***	-2.511***	-2.100	-3.526
Observations	703	699	743	738
Pseudo R-squared	0.262	0.272	0.671	0.612
Marginal effect of assets	0.035	-0.196	-0.017	-0.01
Marginal effect of debt & assets	0.038	-0.189	0.001	0.006

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

These results suggest that a strategy for accumulating assets tailored to specific vulnerabilities facing EMs could potentially yield significant benefits. However, such a strategy also entails costs as we discussed before (subsection A) and is not the only mechanism available to insure against crises. Asset accumulation should be a complement and is often a consequence of sound economic policies. Figure 4 reminds us that EMs typically experience crises when policies and fundamentals are deteriorating and buffers are

[13] The chosen cutoff for NPV haircuts is in the ballpark of those used in IMF (2014, Annexes II and III) to distinguish between "light" and "deep" restructuring.

weak. Furthermore, there are other crisis prevention instruments which could potentially be deployed together with assets, including bilateral swap lines, regional financing arrangements, precautionary financing facilities from the IMF and other international financial institutions, and even market-based hedging (IMF (2016b) discusses some of these mechanisms in the broad context of global financial safety net).

E. Robustness of the Results for the Probability of Debt Distress

As in the quantile regressions, we tested the robustness of the baseline results. It is important to note that our comprehensive list of controls already raises the bar for assets, i.e., it leaves less unexplained variations in the dependent variable to be accounted for by assets. Including them in the regressions also helps mitigate omitted variable problems.

But as in the quantile regressions, we also include the output gap in the baseline specification to further check for omitted variable problems. The statistical significance of the individual coefficients on assets is weaker than in the baseline but the marginal effect on the default probability is significant for all but one asset category (Table A 7). The coefficient on the output gap comes with positive sign and is significant across all asset categories. As mentioned before, a large positive output gap may be a leading indicator of distress.

To test the robustness of the findings for EMs, we run the baseline regressions dropping the observations for advanced economies (Table A 8). Despite the smaller sample, the marginal impact of assets on the probability of debt distress is statistically significant for all categories but assets held in debt instruments. Noteworthy, the joint marginal impact of gross debt and assets for the two liquid categories is stronger than in the baseline regressions, further reinforcing the view that asset liquidity is an important attribute for reducing risks in EMs.

Finally, we test whether "rare events" is an issue in our sample. Most crises identified since the 1980s do not enter the regressions because the availability of data on assets constrains the size of the regression sample. The frequency of crisis in the regression sample, i.e., the unconditional probability of debt distress is quite small (about 2 percent). Therefore, crises seem to be rare events, potentially leading to small-sample bias.[14] We address this issue in two different ways.[15]

[14] It is well known that maximum likelihood estimation of non-liner regression models with discrete dependent variable suffers from small-sample bias and this bias depends on the number of observations in the less frequent of the two categories (crisis, no crisis). As note by Allison (2012), "The problem is not specifically the *rarity* of events, but rather the possibility of a small number of cases on the rarer of the two outcomes. If you have a sample size of 1000 but only 20 events, you have a problem. If you have a sample size of 10,000 with 200 events, you may be OK. If your sample has 100,000 cases with 2000 events, you're golden" (http://statisticalhorizons.com/logistic-regression-for-rare-events). Also, see King and Zeng (2011).

[15] We also run the baseline model using logistic regression and penalized maximum likelihood estimation (MLE), which King and Zeng (2001) and others have found to reduce small-sample bias in MLE and mitigate

First, we broaden the baseline definition of debt distress to also include spikes in sovereign bond spreads as defined above in subsection D. This broader definition is intended to capture instances of severe market stress including in AMs, which rarely default or restructure debt in our sample. This allows to identify 149 debt distress episodes, 33 in AMs and 116 in EMs.

Under this broad definition of debt distress, the correlation between gross debt and crisis probability is weaker than in the baseline because many episodes are triggered by market stress in AMs, which compared to EMs can sustain higher debt levels and rely less on assets as a signaling device (Table A 9). The marginal impact of the two measures of liquid assets on the likelihood of crisis in EMs is statistically significant, and stronger than in the baseline sample. And so is the joint marginal impact of gross debt and assets. Roughly similar results are obtained if we use a lower cutoff for spreads AMs (500bps). The estimates imply that a 10-percentage point increase in debt and assets would reduce the crisis probability by about 6 percentage point in EMs.

Second, we run the probit regressions using the baseline definition of debt distress and WEO data on assets, taking advantage of the longer time span of the WEO database. The regression sample includes about 200 additional observations compared to the other asset categories (Table A 10). The coefficient on assets for the overall sample is statistically significant but we do not find a differentiated impact for EMs as we did before for the two liquid categories. This probably reflects the fact that WEO data mixes information on liquid and less liquid assets across countries (see details in the Appendix).

Overall, the robustness tests suggest that the key baseline result still holds, i.e., assets (especially those in liquid forms) have a significant marginal impact on the probability of debt distress. However, the evidence across all asset categories is less systematic.

VI. Illustrative Simulations

We use the baseline quantile and probit regressions to derive counterfactual asset levels that could inform asset-liability management strategies in practice. We assume a country with macro fundamentals at the median for EMs, and starting with two possible debt levels: 70 and 90 percent of GDP. The first benchmark is at the 75th percentile of the gross debt distribution for EMs in our sample, and treated as a high-risk benchmark in the IMF's debt sustainability framework for market-access countries (IMF (2013)). The second is around the 90th percentile of the distribution and is closely associated with debt distress (1/3 of defaults and restructurings in EMs occurred at debt levels above 90 percent of GDP in our sample).

We conduct two scenarios. In the first, we ask the following question: how much assets

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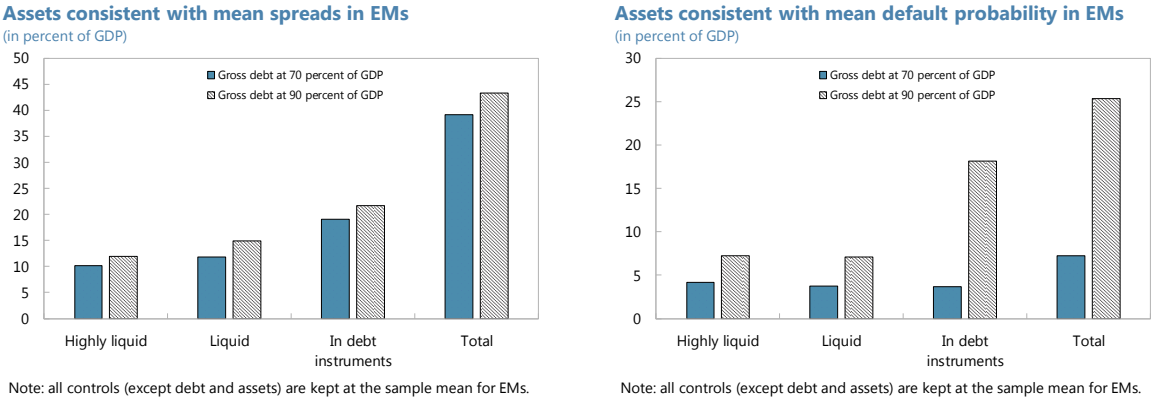
the separation problem in probit/logistic regressions due to small samples. The coefficients on assets for EMs remain with the expected sign but only that on total assets is statistically significant.

would be required to reduce spreads from the 90th percentile of the spread distribution (600 basis points) to the sample mean (300 bps)? Interestingly, the answer depends more on asset quality than on initial debt level. The first panel of Figure 7 shows that the strategy would require asset holdings of around 10-15 percent of GDP for the more liquid categories up to 40-45 percent of GDP if all possible financial instruments (liquid and not liquid) are considered.

Figure 7. Counterfactual Asset Levels Conditional on Initial Gross Debt



Note: all controls (except debt and assets) are kept at the sample mean for EMs.

Note: all controls (except debt and assets) are kept at the sample mean for EMs.

In the second, we ask: how much assets would be required to reduce the likelihood of debt distress to the sample mean (5 percent)? The second panel of Figure 7 shows that the answer depends on both initial debt level and asset quality. An initial debt of 70 percent of GDP would require asset holdings of 3.5-7.5 percent of GDP, depending on the asset category. However, because marginal effects are non-linear in the probit model, an initial debt of 90 percent of GDP would demand larger asset holdings, between 7 percent of GDP for the liquid categories to about 25 percent of GDP for the less liquid ones.

At a broader level, these estimates illustrate that asset quality and policy goals do matter for the design of asset-liability management strategies. However, the strategy would not be an isolated policy action. It would probably be accompanied by other measures to improve the fiscal position and debt profile. In fact, fiscal savings could be the only option available for accumulating the needed asset buffers. To the extent that such measures complement each other, the required asset position could be lower than what the counterfactuals suggest.

VII. CONCLUDING REMARKS

Our investigation makes several contributions to the literature. We consider the role of distinct assets categories on borrowing costs and default probability. We use information on assets for both advanced and emerging economies and estimate the impact of assets across the sovereign spread distribution, without having to slice the data and induce unnecessary bias in our estimations. We find that assets reduce risks to debt sustainability in EMs, and that asset attributes (notably liquidity) also matter.

Our investigation started with a linear model and then included quantile regressions to account for possible nonlinearities. This allowed us to uncover relevant nonlinear effects of assets across the conditional distribution of spreads. We find that assets are particularly relevant for reducing borrowing costs in the riskiest EMs but less so in AMs. We then used a pooled probit to estimate the impact of assets on the likelihood of debt distress and found that asset liquidity is key for reducing crisis probability in EMs. Our results survive several robustness checks and do not seem to be an artifact of the data or econometric specification.

Our results have relevant practical implications. First, they suggest that countries that manage to accumulate asset buffers could strengthen their market access conditions and debt sustainability prospects. While recommending an optimal asset accumulation strategy is beyond the scope of this paper (e.g., it would require full analysis of implied costs and benefits), the results hint that country-specific circumstances would dictate the choice of the size and profile of asset holdings.

For instance, liquid assets that can be deployed on short notice could benefit more those countries that are more vulnerable to rollover risks or are trying to establish market access, whereas long-maturity assets could be more useful for countries with future liabilities. In both cases, the magnitude of the assets would need to be compatible with the size of the fiscal needs.

While our results show that the impact of assets on borrowing costs and default probability may at times outweigh that of gross debt, this does not necessarily imply that assets can always be financed with debt. Assets and liabilities may have different profiles and returns which would prevent exploring this strategy systematically, especially by EMs with weak initial fundamentals and limited market access. Instead, a viable asset accumulation strategy should be anchored by prudent fiscal policies and strong fiscal institutions.

The models estimated in this paper can be also seem as a first attempt at deriving benchmarks for assets and debt distress probabilities. These could be a useful input for debt sustainability analyses and help improve bottom line assessments on debt sustainability. However, this would also require overcoming existing data limitations, including through improving the transparency, coverage and reliability of the information on assets.

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APPENDIX

A. Country Coverage

Advanced markets (AMs): Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, San Marino, Singapore, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.

Emerging markets (EMs): Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Azerbaijan, Bahamas, Bahrain, Barbados, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Gabon, Guatemala, Hungary, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kosovo, Kuwait, Latvia, Lebanon, Libya, Lithuania, Macedonia, Malaysia, Mauritius, Mexico, Montenegro, Morocco, Namibia, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russia, Saudi Arabia, Serbia, Seychelles, Slovak Republic, South Africa, Sri Lanka, St. Kitts and Nevis, Suriname, Swaziland, Syria, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, United Arab Emirates, Uruguay, Venezuela.

B. Control Variables

The next tables show a brief literature survey that informed our selection of control variables, the main control variables used in the regressions, and corresponding data sources.

Table A 1. Determinants of Bond Spreads and Default Probability in the Empirical Literature

Variable	Edwards (1986)	Eichengreen and Mody (2000)	Borensztein and Panizza (2008)	Bellas et al (2010)	Gelos and Sandleris (2011)	Comelli (2012)	Gruber and Kamin (2012)	Cruces and Trebesch (2013)	Catao and Milesi-Ferretti (2014)
Dependent:	Spread	Spread	Spread	Spread	Market access	Spread	Yield	Spread Market access	Default probability
Controls:									
CAB/GDP	x		x	x				x	x
Credit rating		x	x					x	
Debt/GDP	x	x	x	x[2/]			x	x	
Debt service/exports	x	x							
Default dummy			x					x	
Fiscal balance			x	x			x	x	x[7/]
GDP growth	x	x					x		
GDP per capita			x						x
Inflation			x				x	x	
Political risk				x		x		x	
REER	x								x[7/]
Reserves/GDP	x							x[5/]	x
US interest rate		x[1/]		x[3/]		x[4/]		x[6/]	
VIX				x		x			x

1/ US 10-year treasury rate. 2/ External debt/GDP and short-term external debt/GDP. 3/ US 3-month Treasury bill rate, US 10-year government bond yield, and spread between US 10-year and 3-month rate. 4/ US 3-month Treasury bill rate, and US 10-year government bond yield. 5/ Reserves/imports. 6/ US low-grade corporate yield. 7/ Refers to fiscal and REER gaps.

Table A 2. List of Control Variables and Sources

Group	Variable	Sources
Fiscal variables	Financial assets (percent of GDP)	Eurostat, OECD and GFSY, WEO, IFS
	Gross and net debt (percent of GDP)	WEO and the sources for government assets
Macro controls	Real GDP growth (percent)	WEO
	Current account balance (percent of GDP)	WEO
	International Reserves (percent of GDP)	WEO and WDI
	Inflation (percent)	WEO and WDI
	Country credit rating (index 0 to 100)	Institutional Investors
Global fundamentals	VIX index	Fed Saint Louis

C. Asset Data—Government Balance Sheets

The two tables below describe the data sources and discuss the pros and cons of the asset categories used in the baseline estimations.

Table A 3. Categories of Financial Assets: Pros and Cons

CATEGORY	PROS	CONS
Total	Comprehensive measure	Includes illiquid assets Includes assets that are not readily available Includes assets that may not be properly valued
Held in Debt Instruments	Symmetry with gross debt measure	Includes illiquid assets Includes assets that are not readily available Includes assets that are not properly valued
Liquid	Easily valued	Too narrow for assessing medium and long term risks
Highly liquid	Easily valued Can be liquidated quickly	Too narrow for assessing medium and long term risks

Table A 4. Data Sources and Coverage: Pros and Cons

CATEGORY	Source	PROS	CONS
Total	OECD, Eurostat, GFS	Follows international statistical standards. Consistent across country and time.	Short time series for EMs.
Held in Debt Instruments	OECD, Eurostat, GFS	Follows international statistical standards. Consistent across country and time.	Short time series for EMs.
Liquid	OECD, Eurostat, GFS	Follows international statistical standards. Consistent across country and time.	Short time series for EMs.
Highly liquid	OECD, Eurostat, GFS	Follows international statistical standards. Consistent across country and time. Most liquid category.	Short time series for EMs.
Financial Assets	WEO	Long time series for many countries. Compiled by country experts (desks).	Non-standardized reporting. Significant revisions.

D. Asset Data—WEO

While the data obtained from OECD, Eurostat and GFS are consistent and comparable across countries and time, they have short time coverage for most EMs. WEO data, on the other hand, has less uniform reporting standards but longer time series for most countries. The

instrument coverage and government perimeter of the assets reported in WEO vary across countries. This is somewhat illustrated in the table below, which presents the results of an informal survey of reporting standards with IMF country desks of top asset holders.

Typically, assets reported by country desks are a subset of the assets reported in balance sheets, but for many AMs the former is equal to the total reported in the latter. On the other hand, the desks of many EMs tend to report either assets held in debt instruments or a smaller subset (e.g., *liquid*, *highly liquid*).[16] In practice, IMF country desks report net debt, hence assets based on WEO data are obtained by subtracting net debt from gross debt.

Table A 5. Survey on WEO Reporting Standards—Top Asset Holders

Country		Assets WEO Apr 2016 (percent of GDP)	Instrument coverage 1/	Government perimeter 2/	Relevant sovereign wealth funds included (SWFs)	Assets of SWFs 3/
Norway	Norway	306.2	A1+…+A8	GG	Government Pension Fund Global	$847.6 billion (220% of GDP)
UAE	United Arab Emirates	278.2	A1+…+A8	GG	Abu Dhabi Investment Authority	$792 billion (230% of GDP)
Libya	Libya	127.5	A1+…+A8	CG	None	--
Japan	Japan	120.0	A1+…+A8	GG	None	--
Finland	Finland	108.7	A1+…+A8	GG	None	--
Canada	Canada	64.8	A1+…+A8	GG	Alberta Heritage Savings Trust Fund	$17.5 billion (4% of GDP)
Sweden *	Sweden	61.4	A1+…+A8	GG	None	--
Saudi Arabia	Saudi Arabia	47.5	A2	CG	None	--
Belgium	Belgium	42.5	A1+…+A8	GG	None	--
Denmark	Denmark	38.9	A1+…+A8	GG	None	--
Uruguay **	Uruguay	38.6	A1+…+A8	PS	None	--
Austria	Austria	38.3	A2+A3	GG	None	--
Brazil ***	Brazil	37.5	A1+…+A8, except A5	NFPS, PS	None	--
Spain ****	Spain	34.0	A1+…+A8	GG	None	--
United States	United States	25.2	A1+…+A8	GG	None	--
Chile	Chile	21.6	A1+…+A8	CG	Stabilization Fund and Pension Reserve Fund	$ 23.8 billion (10% of GDP)

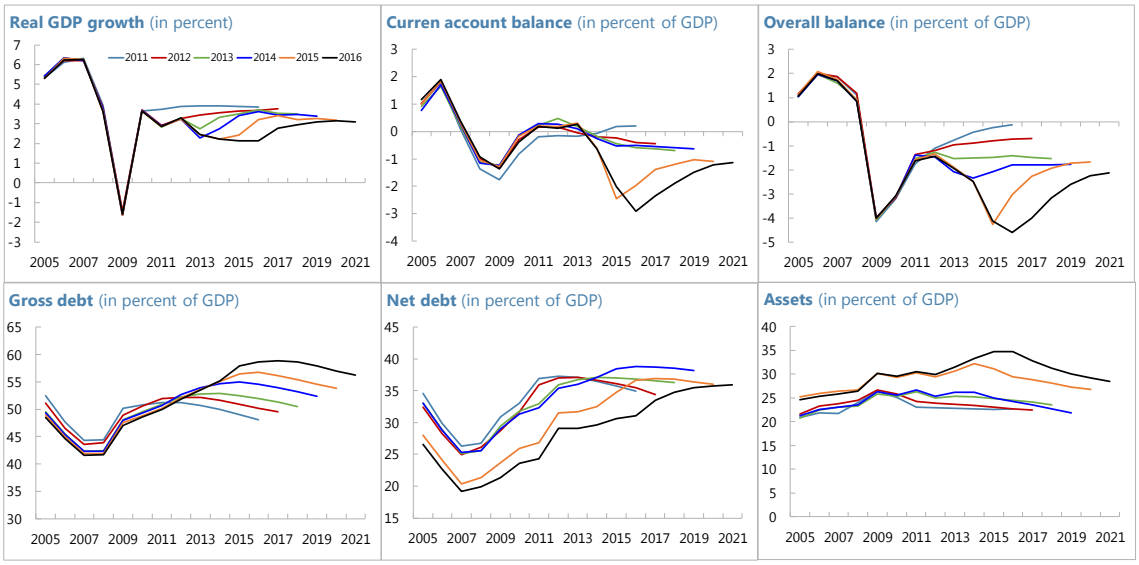
* Includes assets related to "Personal Mandatory Pension".
** Includes the central bank and hence international reserves.
*** Gross debt covers NFPS, net debt covers PS and includes international reserves.
**** The team is revising the definition of financial assets to include only those held in debt instruments.
1/ A1=monetary gold & SDRs; A2=currency & deposits; A3=debt securities; A4=loans; A5=equity & investment fund shares; A6=IPSG; A7=financial derivaties; A8=other acccounts receivable.
2/ CG=central government; GG=general government; NFPS=non-financial public sector; PS=public sector.
3/ Sources: desks, SWF websites, SWF Institute. Reference dates are 2015 and mid-2016.

Furthermore, while most desks report assets at the general government level, over a third reported other government perimeters. The survey also revealed a caveat with obtaining the WEO indicator as a residual: to the extent that gross debt covers one government perimeter and net debt covers another, the underlying assets cannot be related to either. WEO data is also subject to frequent revisions and seems to carry an optimism bias. For instance, while there have been significant downward revisions in the major drivers of debt and assets in recent vintages, asset projections seem more optimistic than macro fundamentals.[17] Given these limitations—which would be addressed by better aligning WEO data submissions with GFSM 2014 recommendations, some caution with the use and interpretation of WEO data is warranted.

[16] The WEO's methodological guide suggests reporting assets held in debt instruments. See Dippelsman et al (2013) for a detailed discussion on issues of coverage.

[17] We use a common sample to compare vintages, so the shift in historical data purely reflects data revision. Because equity is typically recorded at historical cost, revisions are probably more related to other asset instruments, while also reflecting changes coverage and other measurement aspects.

Figure A 1. WEO Projections, April Vintages, Averages Across AMs and EMs



E. Quantile Regressions—Baseline Parameters

Figure A 2. Baseline Quantile Coefficients (Total Assets)

Figure A 3. Baseline Quantile Coefficients (Assets Held in Debt Instruments)

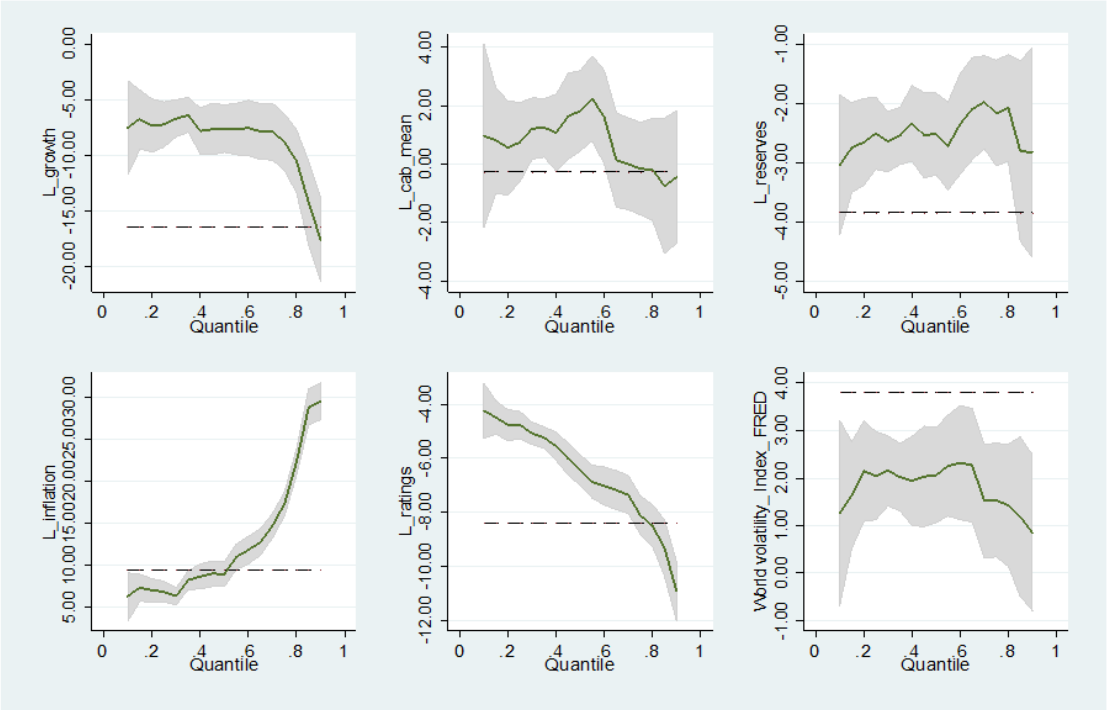


Figure A 4. Baseline Quantile Coefficients (Liquid Assets)

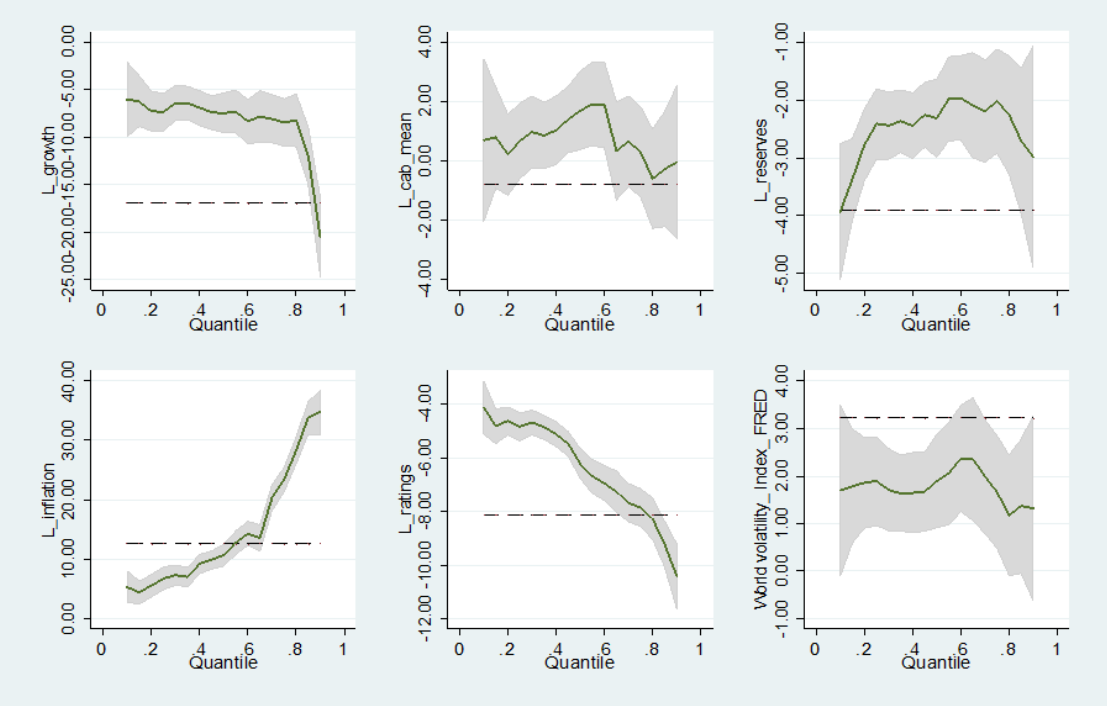
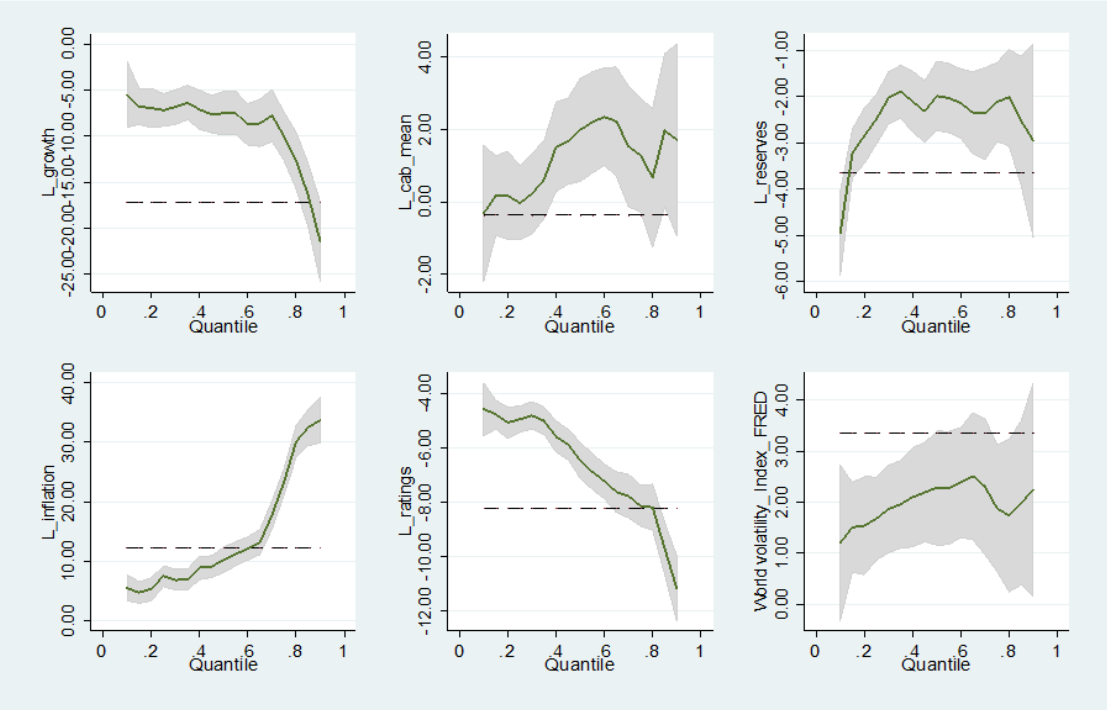


Figure A 5. Baseline Quantile Coefficients (Highly Liquid Assets)



F. Quantile Regressions—Robustness

Figure A 6. Marginal Effect of Debt and Assets on Spreads: Baseline Model and WEO Assets

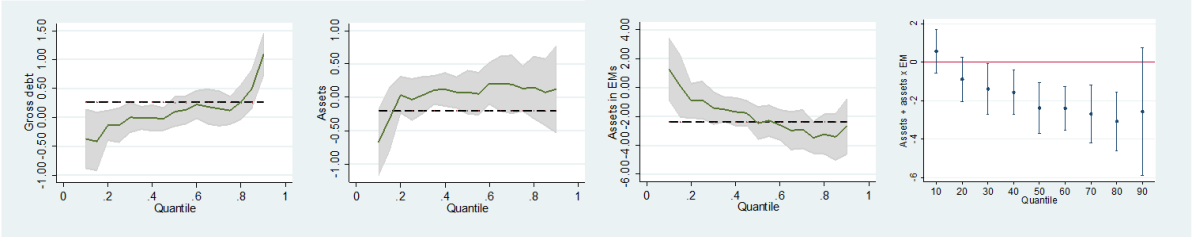


Figure A 7. Marginal Effect of Assets on Spreads: Model including Output Gap

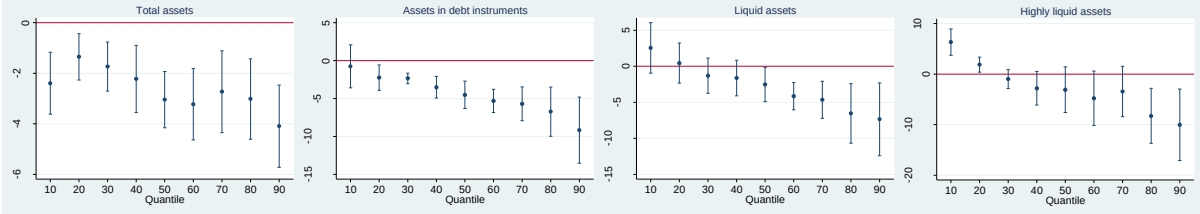


Figure A 8. Marginal Effect of Assets on Spreads: Baseline Model and Sample through 2007

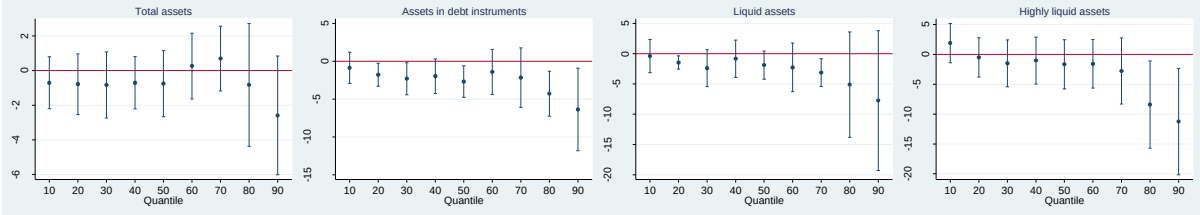


Figure A 9. Marginal effect of assets on spreads: HVR specification and WEO assets

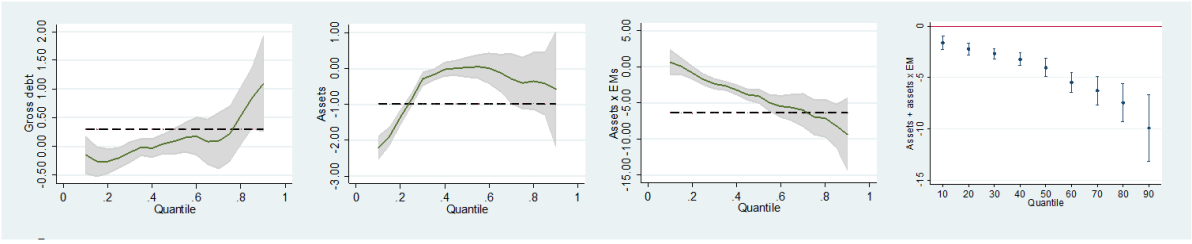
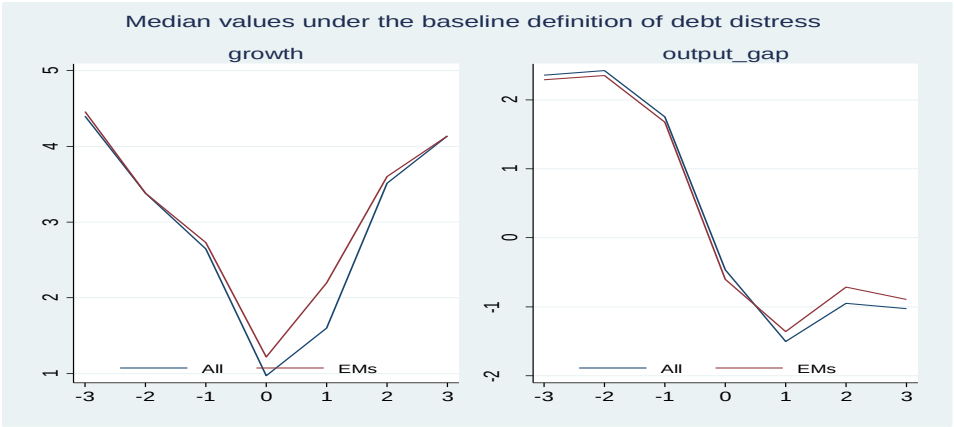


Figure A 10. Growth and Output Gap Dynamics Around Debt Distress Episodes



G. Panel OLS and Probit Regressions—Robustness

Table A 6. OLS Fixed Effect Regressions for WEO (Dep. Variable: Bond Spreads, bps)

Controls	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs
	Baseline				Including default/restructuring dummy			
Debt/GDP, lagged (Λ_1)	1.696**	1.239	1.745**	1.766**	1.665**	1.214	1.713**	1.732**
Assets/GDP, lagged (β)			-0.276	-0.0316			-0.276	-0.0275
Assets/GDP x EM, lagged (γ)				-4.957*				-5.025*
Real GDP growth, lagged	-14.55***	-15.99***	-14.72***	-14.31***	-14.63***	-16.05***	-14.80***	-14.39***
CAB/GDP (3 year avg.), lagged	-12.89***	-11.16**	-12.65***	-12.63***	-12.94***	-11.26**	-12.70***	-12.69***
Reserves/GDP, lagged	-2.913*	-2.606	-2.852	-2.593	-2.822*	-2.506*	-2.761	-2.491
Inflation rate, lagged	15.55***	15.36***	15.55***	15.81***	15.25***	15.02***	15.25***	15.50***
Country credit ratings, lagged	-7.223***	-7.407***	-7.143***	-6.908***	-7.145***	-7.309***	-7.065***	-6.820***
VIX	4.506***	4.458***	4.509***	4.384***	4.538***	4.496***	4.541***	4.417***
Default/restructuring dummy					73.07	85.76	72.99	79.17
Constant	86.38	148.9***	89.18	103.2*	86.17	147.2***	88.96*	103.1*
Observations	815	815	815	815	815	815	815	815
R-squared	0.342	0.336	0.343	0.348	0.343	0.337	0.343	0.349
Number of countries	53	53	53	53	53	53	53	53
F-test for H_0: $\Lambda_1 + \beta + \gamma = 0$			2.282	1.653			2.308	1.719

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

Table A 7. Pooled Probit Baseline Regressions Including Country Output Gap

Controls	Total assets	Assets in debt instruments	Liquid assets	Highly liquid assets
Gross debt/GDP, lagged	2.273***	1.977**	2.379**	2.581***
Assets/GDP, lagged	1.632*	0.294	-4.134	-2.047
Asset/GDP x EM, lagged	-3.369**	-3.828	-14.18*	-15.28
EM dummy	1.200*	1.312*	0.797	0.989
Real GDP growth, lagged	-14.94**	-14.30***	-15.15**	-12.49*
CAB/GDP (3 year avg.), lagged	-10.55**	-11.16**	-9.827*	-11.84**
Reserves/GDP, lagged	-5.964***	-3.487*	-0.891	-3.079
Inflation rate, lagged	5.911**	-2.182	1.383	1.541
Country credit ratings, lagged	-6.093***	-3.344**	-5.233***	-5.774***
Output gap	17.79***	12.25***	16.32***	13.99***
VIX	4.267	3.926	5.601	5.386*
Constant	-4.976***	-4.409***	-4.676***	-4.890***
Observations	707	709	704	703
Pseudo R-squared	0.58	0.51	0.58	0.58
Marginal effect of assets	-0.03*	-0.07	-0.32***	-0.31**
Marginal effect of debt & assets	0.01	-0.03	-0.28**	-0.26*

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

Table A 8. Pooled Probit Regressions for EMs Only

Controls	Total assets	Assets in debt instruments	Liquid assets	Highly liquid assets
Gross debt/GDP, lagged	7.050***	4.538***	6.792***	7.252***
Assets/GDP, lagged	-2.362**	-5.786	-43.88***	-44.94***
Real GDP growth, lagged	-8.337	-11.00**	-13.89	-8.856
CAB/GDP (3 year avg.), lagged	-37.90***	-23.82***	-27.26**	-27.23**
Reserves/GDP, lagged	-14.56**	-6.723*	-5.821	-7.248
Inflation rate, lagged	3.169	-2.345	-1.894	-1.387
Country credit ratings, lagged	-4.870**	-1.452	-3.246	-4.500**
VIX	14.77***	12.25***	21.92***	19.43***
Constant	-8.051***	-5.820***	-8.286***	-7.903***
Observations	226	232	227	226
Pseudo R-squared	0.53	0.47	0.61	0.61
Marginal effect of assets	-0.09*	-0.27	-1.54**	-1.57***
Marginal effect of debt & assets	0.18***	-0.06	-1.3*	-1.32**

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

Table A 9. Pooled Probit Regressions for the Broad Definition of Debt Distress

Controls	Total assets	Assets in debt instruments	Liquid assets	Highly liquid assets
Debt/GDP, lagged	0.687*	0.787*	0.702*	0.755*
Assets/GDP, lagged	0.453	0.394	-1.481	1.507
Assets/GDP x EM, lagged	-0.817	-1.468	-11.71**	-15.08**
EM dummy	0.374	0.540	0.807*	1.045**
Real GDP growth, lagged	-10.03***	-9.844***	-11.61***	-10.57***
CAB/GDP (3 year avg.), lagged	-7.549**	-7.245*	-7.062*	-7.079*
Reserves/GDP, lagged	-2.902**	-2.740**	-1.057	-2.134
Inflation rate, lagged	4.797	0.222	3.200	3.713
Country credit ratings, lagged	-2.365**	-2.497***	-1.998**	-2.137***
VIX	4.555***	5.316***	4.836***	4.375***
Constant	-3.114***	-3.129***	-3.021***	-3.114***
Observations	693	693	690	689
Pseudo R-squared	0.295	0.281	0.328	0.329
Marginal effect of assets	-0.018	-0.056	-0.646**	-0.665**
Marginal effect of debt & assets	0.016	-0.015	-0.612**	-0.628*

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.

Table A 10. Pooled Probit Regressions for WEO Assets

Controls	Gross debt	Net debt	Gross debt & assets	Gross debt & assets & EMs
Debt/GDP, lagged	0.789*	0.970**	0.725	0.732*
Assets/GDP, lagged			-6.738*	-5.832**
Assets/GDP x EM, lagged				-1.249
EM dummy				-0.101
Real GDP growth, lagged	-4.435	-4.015	-6.064	-6.116*
CAB/GDP (3 year avg.), lagged	-9.404***	-8.910***	-8.270***	-8.267***
Reserves/GDP, lagged	-2.611**	-2.599***	-1.969**	-1.946**
Inflation rate, lagged	6.363***	6.966***	8.345***	8.546***
Country credit ratings, lagged	-2.649***	-2.581***	-2.054***	-2.292***
VIX	4.681***	4.795***	4.544***	4.579***
Constant	-3.769***	-3.815***	-3.250***	-3.210***
Observations	953	953	953	953
Pseudo R-squared	0.319	0.334	0.368	0.369
Marginal effect of assets				-0.229
Marginal effect of debt & assets			-0.194*	-0.205

***, **, * denote significant at 1%, 5%, and 10%, respectively, based on robust standard errors.