Who Holds Sovereign Debt and Why It Matters[*]

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May 4, 2022

Abstract

The behavior of the investors in sovereign debt can have important implications for the ability of governments to borrow during distress periods, such as the on-going pandemic and armed conflict crises. To study this issue, we construct an aggregate data set of sovereign debt holdings by foreign and domestic investors, further disaggregated into banks, non-bank private, and official investors for 95 countries over twenty years. Analyzing these holdings leads to several important findings. First, increases in the outstanding supply of sovereign debt is largely absorbed by private non-bank investors. Per additional unit of debt, these non-bank investors absorb 69% despite accounting for only 46% of the outstanding amounts on average. Second, utilizing a more granular data set of euro area investors, we find that investment funds play the largest role among private non-bank investors, rather than insurance and pension funds or non-financial investors. Third, we use an investor demand framework to estimate investor demand functions using the market-clearing identification implied by our data. Although investor demand for AE debt is relatively insensitive to government yield, demand for EM debt is significantly related to yield across investor groups. Counterfactual analysis shows that an increase in debt for an average EM country would lead to a proportionally higher increase in borrowing costs across its overall creditors, but an out-sized increase if private non-bank investors disappear. Taken together, our analysis suggests that EM sovereign borrowing is highly vulnerable to non-bank investors such as hedge funds and mutual funds.

JEL-Codes: F34, G11, G15, F41
Keywords: Sovereign debt, Banks and Non-banks, Advanced Economies and Emerging Markets

1 Introduction

The ability to issue debt is an important instrument at the government's disposal. Sovereign borrowing can help buffer the economy from the impact of adverse macroeconomic shocks. Conversely, indebtedness can also make a country vulnerable to financial distress as crisis episodes have illustrated. Indeed, the sharp increase in fiscal expenditures and debt issuance during the recent pandemic period, as well as concerns from the fallout of war, has brought more urgency to understanding how a government can borrow. Answering this question requires knowledge of who invests in sovereign debt and how these investors impact borrowing costs.

   Therefore, this paper provides an analysis of who holds government debt and the implicit vulnerabilities to future funding by governments. We begin by documenting the investor base of government debt around the world and establishing some new empirical regularities. For this purpose, we first assemble a dataset with a balanced sample of 95 countries spanning 1995-2018 that distinguishes the holders of each country's sovereign debt by foreign and domestic investors and into three subgroups within those categories.[1] Specifically, the data set categorizes these three subgroups into private banks, other private investors that we term "non-banks", and official creditors consisting largely of central banks and international organizations like the World Bank.[2]

   Looking at how the composition of investors changes with the supply of debt and other factors sheds light on the likely response of these investors to future developments. Figure 1 motivates this analysis by showing both the growing importance of government debt as well as how the domestic versus foreign investor base has changed. Specifically, Panel (a) shows that aggregate government debt as a proportion of GDP has increased to the highest levels in recent history, spurred on by the Covid-19 pandemic for both for advanced and emerging economies.

   Furthermore, the types of investors have changed significantly over time. For example,

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[1]The full, unbalanced sample includes 152 sovereigns from 1991.
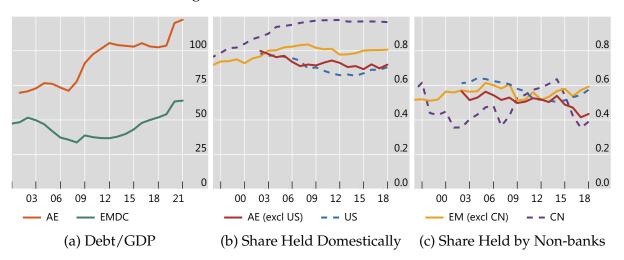[2]This decomposition follows that of Arslanalp and Tsuda (2012) and Arslanalp and Tsuda (2014).

Figure 1: Trends in General Government Debt

(a) Debt/GDP (b) Share Held Domestically (c) Share Held by Non-banks

Note: Panel (a) of this figure plots the time-series of general government debt-to-GDP ratio for the advanced economies, emerging market and developing countries from IMF WEO. Panel (b) plots the share of general government debt held by domestic investors by country group. Panel (c) plots the share of general government debt held by non-banks. Panels (b) and (c) consist of balanced samples of 15 AEs (including the US) and 15 EMs (including CN).

as Panel (b) shows, the share of domestic versus foreign investors has evolved with marked differences between advanced economies (AEs) and emerging markets (EMs). In particular, the share of aggregate debt holdings by domestic investors has decreased for AEs while that same share has increased for EMs. The share of debt held by non-bank investors, shown in panel (c) shows less of a steady trend but more short-term fluctuations. These relationships highlight how the investor base may evolve, either from long term trends or short term shocks.

To understand such changes, we first use our data to ask how increases in the supply of debt are absorbed by each of the six aggregate investor groups: Foreign Bank, Foreign Non-Bank, Foreign Official, Domestic Bank, Domestic Non-Bank, and Domestic Official (Central Banks). Strikingly, we find that Non-Bank private investors increase their holdings of sovereign debt at significantly higher rates than any other group, including private banks. Furthermore, this absorption rate is greater than proportional to their average holdings. Across all countries for instance, when there is an increase in debt, 69% of the increase is allocated to non-bank investors, even though they make up only 46% of holdings on average. For increases in foreign hold debt, 75% of the increase is due to Non-bank investors, even

though they make up 42% of all foreign holdings. By contrast, banks hold 28% of the debt on average, but only abosrob 20%. Foreign Banks account for 14% of foreign holdings of debt on average but only absorb 10% of any expansion in foreign debt holdings. Moreover, this pattern holds for increases in domestically held debt as well as in subsamples of AEs and EMs separately. Moreover, these results are robust to accounting for currency valuation effects on foreign-held debt. Thus, when the supply of government debt increases, Private Non-Bank investors play a significantly larger role than other investors in holding this new level of supply in the government debt market.

These aggregate results highlight the importance of Non-bank private investors, a large and heterogeneous group. To disentangle the behavior of different investors within this group, we turn to a more granular data set of Euro Area investors.[3] This data set allows us to disaggregate the Non-Bank investor group into non-financial corporations, pensions and insurance companies, households, and a category of other financial institutions, largely representing investment funds. With this more disaggregated group of investors, we find once again the importance of Non-bank private investors as the largest marginal investor group. Furthermore, our analysis indicates that within this group, financial institutions such as investment funds drive the large response of non-banks.[4]

In order to understand the impact on borrowing costs of the aggregate investor groups, we develop a conceptual investor framework. Similar to Koijen and Yogo (2020), we consider a two-step investor decision process. Initially, investors decide how much of their portfolio to allocate to sovereign debt holdings in total. Given this decision, investors choose the countries in which to lend based upon country-specific variables. We then cast the framework into an empirically estimable demand function format and explore the response of holdings to bond yields and other macro-financial factors for AE and EM debt separately. Specifically, to identify investor responses to yield changes, we exploit the relationship in

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[3]Although we use these data to supplement our analysis of sovereign debt holdings, Faia, Salomao, and Veghazy (2022) provide a much more granular study of Euro Area investor portfolio holdings.

[4]By contrast, households and non-financial corporations appear to play little to no part in sovereign debt holdings.

our data that the supply of each country's sovereign debt is held by a given set of investor groups. Thus, given the total holdings of each investor group by borrowing country, we construct a pseudo-yield that would hold by group. This pseudo-yield is used to instrument the investor demand equations.

Our analysis provides striking results that highlight important differences between the demand for AE and EM sovereign debt. For the EM sovereign debt, Foreign Non-bank investors have higher elasticities than Banks. Combined with the higher response of Non-bank investors to increases in supply, exposure measures indicate a very high reliance of debt costs to Non-bank investors. Indeed, a 1% increase in EM sovereign debt would correspond to a 1.54% increase in borrowing costs, compared to a baseline increase of 1.38%. This is driven primarily by foreign non-bank investors.

By contrast, estimates of demand for AE debt show quite different behavior. In particular, demand by the banking sector and the official sector are barely affected by the sovereign bond yield. For Banks, this pattern may reflect holdings of AE sovereign debt as liquid assets to satisfy liquidity needs and liquidity regulation requirements. Similarly, in the official sector, central banks may hold AE sovereign debt as foreign reserves. Clearly, these sectors do not hold AE sovereign debt for yield and thus do not respond much to yield changes. Nevertheless, for AE sovereign debt, both Domestic and Foreign Non-banks are responsive to yields, again pointing to the importance of these investors.

The structure of the paper is as follows. Section 2 describes the data and some basic stylized facts, including a decomposition that highlights how much government debt each investor group absorbs on the margin. It also reports the same decomposition using disaggregated non-bank investor holdings in the Euro Area. Section 3 sets up a simple conceptual framework to explore investor demand in the sovereign debt market and reports estimates of this demand by investor groups for AE and EM sovereign debt. Section 4 combines the country-level investor demand identification with the marginal absorption estimates to develop the counterfactual analysis. Concluding remarks follow.

4

Related Literature   As this paper is related to a large literature on government debt, we highlight only a few papers within several strands of research here. First of all, it is related to the literature on the risks of sovereign debt, particularly debt issued by emerging markets. See for example (Arellano, 2008; Arellano, Bai, & Mihalache, 2020; Arellano & Ramanarayanan, 2012). While much of this literature focuses on the preferences of the issuers, we focus on the preferences of the heterogeneous investor groups faced by the issuers.

By studying the impact of investors in this market, we contribute to a growing literature that studies the effects of specific investor groups on sovereign debt. This literature has focused on domestic banks (Chari, Dovis, & Kehoe, 2020; Fahri & Tirole, 2018; Gennaioli, Martin, & Rossi, 2014; Perez, 2014), foreign banks (Bocola, 2016; Morelli, Ottonello, & Perez, 2020), and domestic private investors (Coimbra, 2020). By looking at the effects across these investor groups, we also contribute to research on the consequences of sovereign investor composition for borrowers. For example, some study the impact of domestic versus foreign investors (Bocola, Bornstein, & Dovis, 2019; Bocola & Dovis, 2019; Broner, Clancy, Martin, & Erce, 2018; D'Erasmo & Mendoza, 2021; Mallucci, 2015) or private versus official investors (Dellas & Niepelt, 2016) on the default risk and financing cost of sovereign debt. In contrast to these papers, we provide an empirical framework to examine the implications of these investor groups jointly. Moreover, across these investors, we find a new and important role of the Non-bank sector, both domestic and foreign, which complements these findings in the literature.

Our paper is also related to the literature on investor demand for Advanced Economy sovereign debt. This strand of research includes, for example, Jiang, Krishnamurthy, and Lustig (2018); Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2019); Krishnamurthy and Vissing-Jorgensen (2012); Liu (2021); Liu, Schmid, and Yaron (2020). Consistent with the view in this literature that banks and the official sector hold government debt for liquidity and other purposes, we show that holdings by these groups are relatively insensitive to yields. By contrast, Non-bank private investors increase holdings of AE sovereign debt in

response to increases in yield. We also analyze the role of the global financial intermediaries and financial conditions, as highlighted by Miranda-Agrippino and Rey (2021), Bruno and Shin (2015), Gabaix and Maggiori (2015), Fang and Liu (2020), in driving the holding of sovereign debt by different investor groups. Overall, then, we contribute to the AE sovereign investor demand literature by demonstrating the importance of Non-bank investors.

Our paper is also related to the literature of the demand system approach to asset pricing introduced by Koijen and Yogo (2019) and applied in international financial markets as in Koijen and Yogo (2020), Koijen, Richmond, and Yogo (2020), Koijen, Koulischer, Nguyen, and Yogo (2021), Jiang, Richmond, and Zhang (2020), and Bretscher, Schmid, Sen, and Sharma (2020). While our estimation of different investor groups' demand and the construction of instruments follows the basic approach of this literature, we exploit the market clearing condition from the issuer side. This identity arises naturally in our data because the supply of debt for each country is matched to the full breakdown of holdings by investor groups. As such, this feature contrasts with the common data structure in the literature that focuses upon the portfolio allocation of specific investor groups. See for example, Hau and Rey (2006), Maggiori, Neiman, and Schreger (2020), Coppola, Maggiori, Neiman, and Schreger (2021). We instead choose a borrower-focused approach that analyzes the investors of a given country government debt supply to understand the exposure of issuers. Clearly, both approaches complement each other.

Lastly, we contribute to the literature by constructing a comprehensive dataset of investor groups' holdings in order to analyze the impact of investor composition on sovereign financing cost and fragility. As noted above, this data decomposition is close to Arslanalp and Tsuda (2012) and Arslanalp and Tsuda (2014). In order to examine the impact of marginal investors and their demand, however, we construct a data set that dates back earlier and encompasses a broader set of countries. This more expansive base allows us to estimate the impact of investor composition on sovereigns' financing costs.[5]

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[5]These papers also analyse a funding shock scenario, but largely emphasize the role of foreign investors.

2 Evolving Composition of Sovereign Debt Investor Groups

We begin with a general discussion of the investor group definitions and the data, as well as some basic empirical regularities about how the investor holdings vary with issuances.

2.1 Investor Group Definitions

In order to focus on the evolving behavior of foreign and domestic holders of government debt, we consider three basic investor groups categorized as: (1) banks; (2) private non-banks; and (3) official creditors. We describe briefly these three categories below before detailing their construction in the data.

The first investment group is comprised of private banks. These institutions are often considered primary intermediaries for debt markets and have therefore been the focus of both the Emerging Market (EM) and Advanced Economy (AE) branches of sovereign debt studies. In the literature on emerging market borrowing, foreign global banks are often modeled as the primary creditor. In advanced economies, capital regulation typically incentivizes domestic banks to hold domestic government debt due to their zero risk weight.[6] It has been argued that these holdings give rise to the bank-sovereign doom loop.[7] Below, we call the foreign and domestic investors in this group, "Foreign Banks" and "Domestic Banks", respectively.

The second group of private investors is a combination of all private investors who are not banks. These investors are not subject to bank regulatory restrictions but may face other constraints depending on the nature of their business. Overall, this investor group encompasses financial institutions such as pension funds and insurance firms, endowments, mutual funds, and hedge funds, as well as non-financial entities like corporations and households. We refer to the domestic and foreign counterparts of this diverse investor group as,

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We emphasize the role of non-bank investors, particularly noting the composition of the marginal investors (as opposed to average holdings) as important for understanding debt financing exposure of sovereigns.

[6]Bank regulation typically uses risk-weighted assets to compute capital ratios. So, acquiring an asset with a zero risk weight does not reduce the bank's regulatory capital ratios, though it can affect other bank constraints like the leverage ratio.

[7]See for example, Fahri and Tirole (2018).

respectively, "Domestic Non-Banks" and "Foreign Non-Banks".[8]

Finally, we consider official creditors, a group made up of central banks and supranational government agencies. Specifically, the home official creditor group is simply the "Domestic Central Bank" while the "Foreign Official" group includes foreign central banks, other governments, and international organizations such as the World Bank and International Monetary Fund.

Our analysis focuses on the issuers of debt, rather than the portfolio held by a particular set of investors. Specifically, we are interested in how the holdings of these investor groups respond to changes in debt and the attributes of the issuing country. For this purpose, we study the balance sheet of issuers of debt rather than the securities held by a particular set of investors. In particular, our data set provides sovereign debt holdings of each country disaggregated by the investor group. It will therefore be useful to define the debt of a given country, indexed by j, held by each investor group, indexed by i, as H_j^i. Then, clearly, the investor groups for country j debt can be aggregated across the investor groups to provide a measure of the holdings of each country's creditors as:

$$\overline{H}_j \equiv \sum_{i=1}^{I} H_j^i \tag{1}$$

where I is the number of investor groups. For example, in our aggregate data set above, $I = 6$ since we have 3 types of investors with domestic and foreign counterparts for each. Moreover, since these holdings account for the outstanding debt of sovereign j, the total supply of debt D_j must equal the holdings of debt held by Home and Foreign investors through the accounting identity:

$$D_j = \overline{H}_j, \forall j \tag{2}$$

Thus, these holdings allow for a decomposition of domestic and foreign investor groups using the shares of banks, non-banks, and official holdings. For this purpose, let lower cases refer to the shares of each sovereign's debt held by investor group i as: $h_j^i \equiv H_j^i / D_j$. Then

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[8]Below, we study these individual groups on a more disaggregated basis using data for Euro Area investors.

clearly these investor shares sum to one. That is,

$$1 \;=\; \sum_{i=1}^{I} h_j^i \tag{3}$$

We will use the decompositions of the shares in equations (2) and (3) below to uncover the changing patterns of ownership over time. In Section 4, we will combine this information with demand estimates to uncover the risk to borrowers. Before doing so, we describe the data.

2.2 Data

The annual data series for the debt and holding groups come from various sources. Here we describe briefly the overall approach in constructing these data series, although a more complete discussion can be found in Appendix A. The general approach follows the work of Arslanalp and Tsuda (2012, 2014). We modify their methodology in order to broaden the time period and sample of countries. We point interested researchers to their papers and associated database for a full description of the approach.

The overall total debt levels are derived primarily from the IMF Historical Public Debt Database (HPDD) that provides debt-to-GDP for a large number of countries over a long time horizon. , We multiply this series by GDP from the World Bank to recover the value of debt in current US dollars.[9] The foreign total holdings are constructed following the methodology in Avdjiev, Hardy, Şebnem Kalemli-Özcan, and Servén (2018) (AHKS). Constructing the foreign holdings with this methodology relies on data such as the IMF International Investment Position (IIP) data, the Quarterly External Debt Statistics (QEDS), and the BIS international banking and international debt securities statistics. The domestic total holdings are the complement of this series to total debt, and are computed as the difference between total debt and foreign debt.

The domestic and foreign holdings are further decomposed into the three groups described above. Data for foreign bank holdings are estimated using the approach in AHKS.

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[9]For some countries, the HPDD data series stop in 2015. For these countries, we obtain post-2015 values by applying the growth rate in total debt from the Quarterly Public Debt Statistics (QPSD), which has excellent coverage of the recent period, to the last available level computed from the HPDD.

Foreign official holdings for advanced economies and China are taken directly from Arslanalp and Tsuda (2012, 2014), capturing the use of such debt as foreign reserves. For other countries, we use the sum of bilateral and multilateral lending from the World Bank Debtor Reporting System (DRS). Foreign Non-Bank holdings are the difference between these measures and total foreign holdings.

Sovereign debt holdings by domestic banks, and domestic central banks are taken from the IMF's International Financial Statistics (IFS) dataset, supplemented with data from the official websites of central banks when the data was incomplete. The domestic total is computed as the difference between the total debt and the foreign-held debt. Domestic Non-Bank holdings are computed as the difference between the domestic total and the sum of domestic banks and domestic central banks. All holdings in the baseline data series are measured in current US dollars.[10]

Overall, this construction provides a balanced sample of 95 countries from 1995 to 2018 and a full unbalanced sample from 1991 for 152 countries. For some of the analysis, we split the sovereigns into 3 groups: advanced economies (AEs), emerging markets (EMs), and developing countries (DCs).

2.3 Investor Trends and Marginal Holders

Given these definitions, we now examine the relative behavior of each investor group's holdings as government debt changes. Panel (a) of Figure 2 begins by showing the average holdings-to-GDP shares of advanced economy (AE) investors while Panel (b) of the same figure shows the same for the emerging and developing economies (EMDC). These figures show distinctive differences within the groups. For both groups, the foreign bank and non-bank shares have been stable, though small, over time.[11] However, the proportion of foreign official holdings has become larger for AEs, as central banks have increased their

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[10] Alternative measures are also constructed to evaluate robustness to currency valuation effects, as described below.

[11] Foreign official data for advanced economies are not available until 2000, so foreign holdings are not fully reported before that point.

holdings of safe haven government debt for reserve purposes, while that proportion has declined for emerging markets. Strikingly, the share of domestic non-banks has increased over time for EMs relative to AEs, perhaps reflecting growing financial development within these economies. By contrast, the AE holdings of domestic central banks has expanded over time, likely due to the use of unconventional monetary policies.

These trends raise an important question. When the size of debt increases, which investors absorb the additional amount? In other words, who are the marginal investors for the sovereign? To explore this question, we regress the change in debt held by each investor group on the change in total debt:

$$\frac{H^i_{jt} - H^i_{jt-1}}{D_{jt-1}} = \alpha_j + \alpha_t + \beta^i_0 \frac{D_{jt} - D_{jt-1}}{D_{jt-1}} + \epsilon^i_{jt}, \quad \forall i \tag{4}$$

where the subscript t indicates time, and where α_j and α_t represent country fixed effects and time fixed effects, respectively. Using the identities in equations (1), (2), and (3)), the sum of the investor groups add up to the total so that:
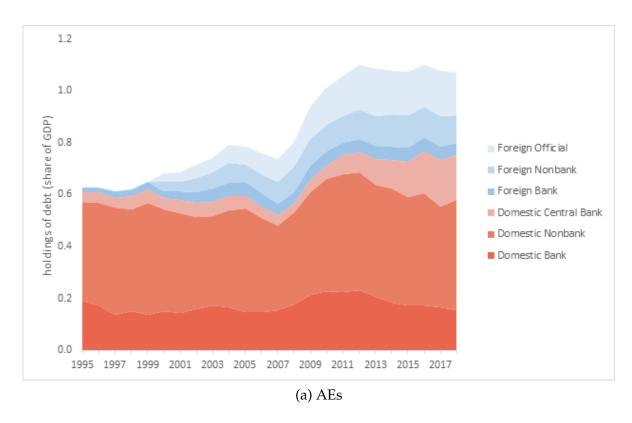
$$\frac{D_{jt} - D_{jt-1}}{D_{jt-1}} = \sum_{i=1}^{I} \frac{H^i_{jt} - H^i_{jt-1}}{D_{jt-1}}. \tag{5}$$
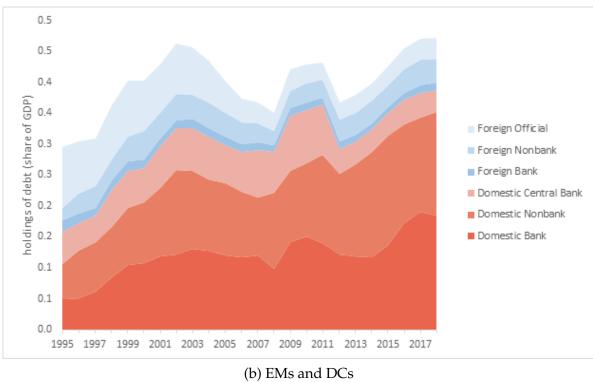
Since all of the debt is absorbed by some investor, the coefficients estimated from this regression will sum to 1: $\sum_{i=1}^{I} \beta^i_0 = 1$. As a result, each coefficient reflects the marginal holding response of each investor group to variations in the supply of debt.

Table 1 shows the results of this regression. Panel A provides a baseline estimate labeled "All" based upon a balanced sample of countries. The first two columns provide these results for an aggregated group of domestic and foreign investors, respectively. Columns (1) and (2) show that for every additional unit of debt supplied, 60% is absorbed by domestic investors while the other 40% is picked up by foreign investors. In AEs and DCs, this split is roughly equal, whereas for EM sovereign debt, domestic investors take over two-thirds of additional debt.

Breaking down foreign and domestic investors by type in columns (3) through (8) reveals additional insights. For the "All" country estimates, non-bank investors tend to be the most

Figure 2: Trends in Sovereign Debt

(a) AEs

(b) EMs and DCs

Note: This Figure plots the debt-to-GDP ratio held by different investor groups for advanced economies (Panel a) and emerging market and developing countries (Panel b).

important, taking on 39% and 30% of additional debt holdings for domestic and foreign entities, respectively. As reported in the following rows, decomposing estimates into country groups shows the relative importance of investor groups across these countries. In particular, foreign non-banks are more important for AEs and DCs, while domestic non-banks matter more for EMs.

Table 1: Marginal Holders of Sovereign Debt

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
Panel A: Marginal Share								
All	0.60***	0.40***	0.16***	0.39***	0.05***	0.04***	0.30***	0.06***
	(0.05)	(0.05)	(0.04)	(0.05)	(0.01)	(0.01)	(0.05)	(0.02)
AE	0.50***	0.50***	0.02	0.39***	0.09	0.06**	0.40***	0.04
	(0.12)	(0.12)	(0.03)	(0.09)	(0.07)	(0.02)	(0.12)	(0.03)
EM	0.68***	0.32***	0.21***	0.43***	0.04**	0.05***	0.24***	0.04
	(0.05)	(0.05)	(0.05)	(0.07)	(0.02)	(0.02)	(0.05)	(0.03)
DC	0.50***	0.50***	0.11***	0.34***	0.05***	0.01	0.40***	0.09***
	(0.09)	(0.09)	(0.03)	(0.09)	(0.02)	(0.02)	(0.10)	(0.02)
Panel B: Average Share								
All	0.57	0.43	0.22	0.28	0.07	0.06	0.18	0.19
AE	0.55	0.45	0.19	0.32	0.04	0.10	0.21	0.14
EM	0.61	0.39	0.26	0.28	0.07	0.06	0.17	0.16
DC	0.49	0.51	0.16	0.24	0.09	0.04	0.17	0.30

Note: Panel A of the table reports the regression coefficients for Equation (4) for each investor group. The first two columns represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups. Standard errors clustered at the country level are reported in the parentheses. Panel B of the table reports the average share of holding by each investor group.

More important, however, is the role of investor groups relative to each other. Here, Non-bank investors again demonstrate the most striking results. For example, Foreign Non-banks play a much stronger role in expanding holdings in response to new debt than do Foreign Banks. In particular, the takeup of new EM debt by foreign non-bank investors is

24% of the total in contrast to only 5% by foreign banks. These findings are in stark contrast to a view that foreign banks play the biggest role in the EM debt market. And lastly, foreign official investors are more important as marginal investors for DCs, where they serve as an important source of financing (9% of the increased supply). These patterns are illustrated in panel (a) of Figure 3.

These results consider the marginal decomposition of investor groups in response to an expansion in country debt and therefore one might wonder whether these holdings are consistent with average holdings. To answer this question, Panel B of Table 1 reports the average holdings by investor group over the period. As these numbers show, the large marginal contribution of non-bank investor holdings are greater than the average holdings. For example, in the baseline "All" results, the average holdings of Domestic Non-banks and Foreign Non-banks sum to only 46% (that is, $0.28 + 0.18$). At the same time, the marginal holdings reported in Panel A are jointly 69% ($0.39 + 0.30$). This pattern is clearly robust across all the remaining decompositions including AE, EM, and DC.

Given that these shares are averages over the sample period, another possibility is that these shares have changed over time, and the marginal share is capturing a increasing trend in the average non-bank holding share over time (due to the increasing size of this sector). Therefore, we compared the averages to the most recent shares in the sample. These more recent shares for the EM country debt were essentially the same as the averages, while the Non-bank shares for the AE country debt were slightly lower. Thus, the non-bank sector appears to be the most important investor on the margin for expansions (or contractions) in debt.

The responses reported in Table 1 simply capture variations in holdings by investor groups measured in a common currency. However, such changes in holdings may arise from currency valuation effects for debt that is originally issued in local currency. Indeed, the importance of valuation effects in the balance sheet adjustment of countries has been shown in a number of papers (e.g. Gourinchas and Rey (2007)).[12] We return to examine

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[12]Valuation effects have also been shown to be important more generally in the portfolio allocation of investors

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more carefully the effects of changes in market valuations in Section 3.2.

At this general level, we first consider whether currency changes may impact the general marginal investor findings in Table 1. To see the potential impact of currency, we define the impact of currency valuation on holdings of sovereign debt j by investor group i as $CV^i_{j,t}$. Then we can rewrite the general relationship for holdings above as:

$$H^i_{jt} - H^i_{jt-1} = \Delta \tilde{H}^i_{jt} - CV^i_{j,t}$$

where $\Delta \tilde{H}^i_{jt}$ is the change in holdings excluding currency valuation effects.

To compute $\Delta \tilde{H}^i_{jt}$, we make two assumptions. First, domestic investors hold sovereign debt in local currency. Second, the local currency share of foreign investors may be proxied by the BIS data on the share of local currency among bonds issued in international financial markets. As we do not have a currency breakdown by investor group, we assume this share applies across all foreign investors.

Under these assumptions, we then calculate the currency valuation adjustment as:

$$CV^i_{jt} = H^i_{jt-1} \times LC_{jt-1} \times \frac{S_{jt} - S_{jt-1}}{S_{jt-1}}$$

where LC^i_{jt} is country j local currency share of debt investor group i's holding of country j's debt, and $S_{j,t}$ is the price of currency j in terms of dollar, both at time t. We define the currency valuation adjusted change in total debt as $\Delta \tilde{D}_{jt} = \sum_{i=1}^{I} \Delta \tilde{H}^i_{jt}$. The regression (4) is in turn written as

$$\frac{\Delta \tilde{H}^i_{jt}}{D_{jt-1}} = \alpha_j + \alpha_t + \beta^i_0 \frac{\Delta \tilde{D}_{jt}}{D_{jt-1}} + \epsilon^i_{jt}, \quad \forall i \tag{6}$$

The subsection in Appendix B.2 reports the same regression results on the marginal investor of sovereign debt taking into consideration the currency valuation effect. As these results show, the general finding that Non-banks have an larger response is robust to this currency valuation adjustment.

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using disaggregated data on holdings of specific investors. See, for example, Curcuru, Thomas, Warnock, and Wongswan (2011) for an analysis of US portfolio investment in foreign equity markets.

2.4 Marginal investors during different circumstances

While these relationships consider the responses of investor holdings over all periods, the composition of marginal investors may change depending on the time period or circumstance. Indeed, the literature on marginal investors has highlighted their importance and differences during crises and recessions (e.g., Bruno and Shin (2015) and Miranda-Agrippino and Rey (2021).) During these times, banks may cut back lending and central banks may intervene to stabilize the economy. Moreover, these cut-backs may impact the overall responses of investor holdings of government debt. Therefore, we examine the sensitivity of investor group holdings to crises and other special circumstances.

To examine marginal investor responses during these time periods, we estimate 4 separately when the country-year is (i) during recession and non-recession periods; (ii) during a banking crisis and not; and (iii) in different sub-periods.[13] We consolidate the results of these regressions into Figures 3 (panels (b) and (c)) and 4, relegating detailed reporting of the regression coefficients to Tables B1, B2, and B3 in Appendix B.

The figures highlight important patterns. Both Advanced Economies and Emerging Market sovereign debt show marked differences in their marginal investors across different circumstances. For example, domestic non-banks absorb more emerging market debt during recessions or banking crises, whereas domestic banks decrease their absorption. In advanced economies, the domestic central bank becomes a key investor during a crisis. After the GFC, both domestic banks and domestic non-banks increase the share of debt they absorb, as well as foreign official lenders in the case of advanced economies. This latter trend may reflect increased holdings of debt in the form of reserves by foreign central banks, particularly those in EM countries.[14]

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[13]We define a country as in a recession if its real GDP growth rate is negative, and a country as in a banking crisis if there is or was a banking crisis in the past 3 years. Banking crises indicators follow Laeven and Valencia (2020). For the sub-periods, we break the sample up into periods around the Global Financial Crisis (GFC), in particular before 2000, from 2000-2008, and after 2009.

[14]If these data were extended through 2020, we might see a much higher marginal share for the domestic central bank, as some in AEs purchased amounts roughly equal to the net issuance of debt during that year (see the IMF Fiscal Monitor).

For developing countries, the role of domestic investors expands considerably during recessions. The pattern over time is also interesting. From 2000-2009, foreign investors play a larger role in picking up debt issued by DC sovereigns, but after the GFC domestic investors' share increases substantially as foreign non-bank investors contract. The share of foreign official has been increasing over time.
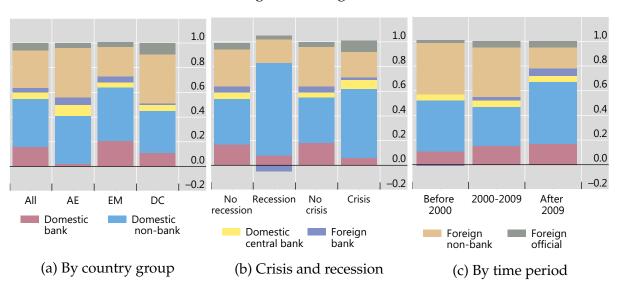
Figure 3: Marginal Holders

(a) By country group   (b) Crisis and recession   (c) By time period

Note: This figure plots the regression coefficients in Equation (4) for all countries under different circumstances. Panel (a) shows the coefficients for each investor group during recession and non-recession times, and during crisis and non-crisis times. A recession is defined by a negative real GDP growth rate. A crisis is identified following Laeven and Valencia (2020), which includes a banking crisis, a currency crisis, and a debt crisis. Panel (b) shows the coefficients for each investor group in three subsamples: pre-2000, 2000-2009, and post-2009.

The basic finding that Non-bank investors are important marginal investors continues to hold across these different periods. The next section examines this investor group in more detail.

2.5 The Role of Non-Bank Investors

As we showed above, private investors who are not banks play an important role in the sovereign debt market. The important role of non-bank private investors implied by these results raises the obvious questions: who are these investors and how do they respond to changes in sovereign debt? To shed light on this question, we turn to a more disaggregated data set: the Euro area securities holding statistics produced by the European Central
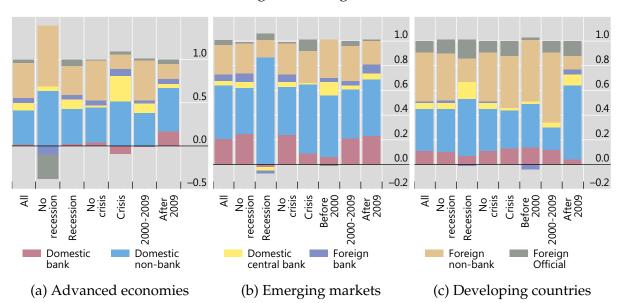
Figure 4: Marginal Holders

(a) Advanced economies (b) Emerging markets (c) Developing countries

Note: This figure plots the regression coefficients in Equation (4) under different circumstances for advanced economies, emerging market economies, and developing countries in Panels (a) through (c). A recession is defined by a negative real GDP growth rate. A crisis is identified following Laeven and Valencia (2020), which includes a banking crisis, a currency crisis, and a debt crisis.

Bank.[15] This source provides data on the holdings of securities by sector of the holder, by the type and sector of the security, and by the residence of the security issuer. Thus, we can observe the holdings of individual government debt for all Euro area investors within a given holder group. Specifically, the non-bank sector in this data has the more granular breakdown: (a) households and non-profits, (b) insurance and pensions, (c) non-financial corporations; and (d) "other financial institutions" which includes entities like hedge funds and mutual funds. As above, we also study the holdings by banks and the official sector. However, in this data source, the official sector is just the government, excluding the central bank. These data are quarterly and span 2013 Quarter 4 to 2020 Quarter 3.

Although these more disaggregated data are useful for examining the responses of investors within the Non-bank category, they require modifications to our aggregate balance sheet approach above for two reasons. First, these Euro Area investors do not represent all of the holdings of the debt of a given country. Therefore, we cannot examine the overall

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[15]Faia et al. (2022) analyze these data for corporate bonds in the euro-area finding significantly different behavior for mutual funds relative to insurance and pension funds, similar to our results below for sovereign bonds.

impact on a borrower. As such, our results can only be interpreted as the effects from a segment of the investor population. Second, in contrast to the aggregate data, these data are collected as a group of investors across countries. Therefore, there is no natural counterpart to domestic investors in our primary dataset. Thus, we focus only on holdings by Euro area investors of sovereign debt from countries outside of the Euro area. As a result, our decomposition only relates to the foreign investor results above. Moreover, since the Euro area investors only hold a portion of total government debt by these countries, we aggregate across debt holdings within the area to measure "total" debt. Thus, the estimates provide a decomposition of overall holdings by Euro area investors only, and do not represent the aggregate debt outstanding.[16]

With these two modifications, we replicate the decomposition of marginal investors in the government debt market. Table 2 shows the results of the regression. Similar to the aggregate data, Columns (1) to (3) show that Non-Bank private investors generally take on additional sovereign debt held in the Euro area. For the base case of all countries, 77% of every additional unit of sovereign debt is held by Non-Banks, while only 23% is held by Banks, and that amount is close to zero for Governments. These general patterns hold for all cases except for Advanced Economies in the baseline estimates in Panel A, where banks seem to absorb the largest share of the increase.

Given the modifications, this decomposition differs from that of Table 1 because the total supply of debt is treated as the total supply within the Euro Area only. Given the importance of the debt from large AE countries such as the US for this group of investors, we also estimate the regressions weighting by the size of country debt. As reported in Panel B, Nonbanks are the larger marginal investor in aggregate even for AE countries while results for EM countries are largely unchanged.

More importantly, columns (4) to (7) provide a decomposition within the Non-bank investor group. In the baseline case of All investor groups, Insurance and Pensions take

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[16] As with the aggregate analysis, we include all countries of the sovereign in the decomposition, including the US. For the Euro area investors, the US provides an important potential Advanced Economy for debt holdings.

Table 2: Marginal Holders of Sovereign Debt - Euro Area

	(1) Gov	(2) Banks	(3) NonBank	(4) HH	(5) InsurPens	(6) NFC	(7) OthFin
			Panel A: Equal weighted				
All	0.00***	0.23***	0.77***	0.01	0.14**	0.00*	0.85***
	(0.00)	(0.07)	(0.07)	(0.01)	(0.06)	(0.00)	(0.12)
AE	0.00	0.53***	0.47***	0.02	0.12*	0.01	0.85**
	(0.00)	(0.14)	(0.14)	(0.01)	(0.06)	(0.01)	(0.29)
EM	0.00***	0.10*	0.90***	0.01	0.14*	0.00	0.85***
	(0.00)	(0.05)	(0.05)	(0.01)	(0.07)	(0.00)	(0.12)
			Panel B: Weighted by D_{jt-1}				
All	0.01	0.23***	0.77***	0.01	0.07***	0.03	0.89***
	(0.00)	(0.06)	(0.06)	(0.00)	(0.02)	(0.03)	(0.11)
AE	0.01	0.27**	0.73***	0.00	0.06**	0.04	0.89***
	(0.01)	(0.09)	(0.09)	(0.00)	(0.02)	(0.04)	(0.17)
EM	0.01***	0.11**	0.89***	0.02	0.10***	0.00*	0.88***
	(0.00)	(0.04)	(0.04)	(0.01)	(0.03)	(0.00)	(0.06)

Note: This table reports regression coefficients of Equation (4) on sovereign debt issued by non-European countries for different investor groups within Europe. Columns (1) through (3) reports coefficients for government, banks and Nonbank sector. Columns (4) through (7) disaggregates Nonbanks into households (HH), insurance and pension funds (insurPens), non-financial corporations (NFC), and other financial institutioins (OthFin). Standard errors clustered at country and year level are reported in the parentheses.

on roughly 14% of the additional debt holdings of non-bank investors. This response is dwarfed by the 85% absorbed by "other financial institutions" such as hedge funds and mutual funds. By contrast, the other two categories of Households and Non-financial companies essentially take on little to none of the additional government debt. This pattern is similar across the debt from both AEs and EMs, and whether the estimates are weighted by debt size or not.

Overall, these disaggregated data suggest that the Non-bank investor group is largely driven by the behavior of mutual funds and hedge funds. Of the remaining groups, only the insurance and pension funds have a significant impact on Non-bank responses to debt, and even these institutions contribute much less.

3 Investors and Sovereign Debt Allocations

We showed above how the composition of investor holdings varies when sovereign debt expands on the margin. However, these results do not address how this ownership is related to characteristics of a borrowing country and global financial conditions. This section therefore begins to examine this question.

We develop this analysis in three parts. Section 3.1 describes a conceptual framework that relates investor sovereign debt allocations to variations in global and country-specific variables. Section 3.2 and Section 3.3 then use this framework to identify and estimate the investor demand for the government debt of EM and AE countries, respectively. In Section 4, we will use these estimates to determine the funding exposure of borrowing countries.

3.1 A Conceptual Framework

Since our data provides the full investor base for each country, we focus on understanding differences in demand for sovereign debt holdings across these groups. We therefore develop next a conceptual framework of investor behavior to be utilized in our empirical analysis below. For this purpose, we describe the behavior of a generic investor group i holdings of the book value of country j debt, previously defined as $H_{j,t}^i$.

Investor holdings of sovereign debt are typically driven by both global shocks and country-specific characteristics. To highlight this distinction, we consider the investor's decision to hold a given country's debt as the outcome of a two-step decision.[17] In the first step, investors decide their total allocation to sovereign debt as a share of total net worth, defined as: $h_t^{i,N} \equiv H_t^i / N_t^i$ where N_t^i is the net worth of investor group i. Following the literature, we postulate that investors allocate their overall portfolio to sovereign bonds depending upon "global factors" $\mathbf{X}_t^w$.[18] In this case, the desired portfolio share of aggregate sovereign bonds

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[17]Koijen and Yogo (2020) use a similar two- step decision to summarize investor decisions at the country level across an allocation into total short term debt, long term debt, and equity.

[18]See for example Gabaix and Maggiori (2015), Fang and Liu (2020), and Morelli et al. (2020).

for investor of group i can be written in the form:

$$h_t^{i,N} = h^{i,N}[\mathbf{X}_t^w] \tag{7}$$

In the second step, investors decide which countries to invest in as a share of total sovereign debt holdings defined as: $h_{jt}^{i,H} \equiv H_{jt}^i / H_t^i$. This decision for holdings of country j government debt by that same investor *within* the sovereign allocation depends upon country-specific macro-variables $\mathbf{X}_{j,t}$ and the characteristics of the debt, $\mathbf{Z}_{j,t}$. In other words, this share can be written as:

$$h_{j,t}^{i,H} = h^{i,H}[\mathbf{X}_{j,t}, \mathbf{Z}_{j,t}; \mathbf{X}_t^w] \tag{8}$$

Clearly, one important characteristic that affects investors' demand is the return on holding that debt, typically measured as the yield to maturity. This yield is determined by equating investor demand with the issuer supply of debt, and is therefore endogenous. For expositional clarity, therefore, we separate the yield, defined as $y_{j,t}$, from the other debt characteristic vector $Z_{j,t}$ in the subsequent analysis.

Combining the portfolio share decisions in Equations (7) and (8) into the overall portfolio share identity provides the desired holdings by investor groups in terms of country and global variables:

$$H_{jt}^i \equiv h_t^{i,N} h_{j,t}^{i,H} N_t^i = h^{i,N}[\mathbf{X}_t^w] h^{i,H}[\mathbf{X}_{j,t}, \mathbf{Z}_{j,t}, y_{j,t}; \mathbf{X}_t^w] N_t^i. \tag{9}$$

Therefore, the sovereign debt demand depends upon characteristics of the borrower countries $\mathbf{Z}_j$ and their bond yields y_j as well as the global factors $\mathbf{X}^w$.

By contrast, the supply of debt depends upon a governments desire to borrow at a given price schedule, as is typical in the quantitative sovereign debt literature (e.g., Arellano (2008)). Our data summarizes this supply as a book value of debt at the end of each year. Defining the Debt-to-GDP ratio for country j as: $d_j \equiv D_j / Y_j$, where Y_j is GDP, Appendix C describes how this relationship can be written as a policy function. In particular, this policy function relates macro and other country-specific variables to the supply of government debt as in:

$$d_{j,t} \equiv d(\mathbf{X}_{j,t}; \mathbf{Z}_{j,t}) \tag{10}$$

That is, the share of government debt to output depends upon a vector of country-specific macro-economic variables, $\mathbf{X}_{j,t}$, and debt characteristics, $Z_{j,t}$. Although this relationship holds in general, for our empirical identification below, we require that the supply of debt and its pricing function is predetermined before investors decide on any new holdings. In this case, the supply of debt is exogenous to investor decisions within the period. Under this timing assumption, the supply of debt by country j can be written as a function of the other predetermined variables at time t:

$$D_{j,t} \equiv d(\mathbf{X}_{j,t}; \mathbf{Z}_{j,t}) Y_{j,t} \tag{11}$$

The individual investor group demands for sovereign debt of country j together with its supply implies a market clearing condition that we use below. Specifically, we equate the supply of debt in equations (11) to the sum across all investor groups $i = 1, .., I$ of demand given in equation (9):

$$D_{j,t} \equiv d(\mathbf{X}_{j,t}; \mathbf{Z}_{j,t}) Y_{j,t} = \sum_{i=1}^{I} h^{i,N}[\mathbf{X}_t^w] h^{i,H}[\mathbf{X}_{j,t}, \mathbf{Z}_{j,t}; \mathbf{X}_t^w] N_t^i \tag{12}$$

Our analysis in the next section will use pre-determined characteristics of debt to consider the endogenous impact of variations in the supply of debt. Before doing so, we first consider more carefully the impact of global shocks on the aggregate levels of sovereign debt holdings.

3.2 Investor Demand for EM Sovereign Debt

The results above demonstrate who holds sovereign debt, along with important empirical regularities about their holdings. However, understanding why this composition of debt ownership matters for borrower costs requires uncovering investor preferences that are implicit in these aggregate holdings. For this purpose, we now turn to estimating the investor demand for sovereign debt based on borrowing country characteristics. The approach for both EM and AE countries are the same. Therefore, we start with an analysis of EM sovereign debt here, leaving a description of the results for AE countries to the following

Subsection 3.3. Our identification exploits the full set of investors groups for a given supply of debt by each country. Importantly, this feature contrasts with a common data structure in the literature that focuses upon the portfolio allocation of specific investor groups.[19] Although this investor-focused approach provides important insights into their behavior, each group holds only part of the supply of debt. In order to understand the exposure of issuers, we instead choose a borrower-focused approach that analyzes the investors of a given country government debt supply. Clearly, both approaches complement each other.

Equation (9) shows that investor demand depends upon the net worth of each investor group, a breakdown not available on the level of the supply of sovereign debt holdings by country. For estimation purposes, therefore, we operationalize the conceptual framework by making treating the behavior of domestic and foreign investor net worth differently. For the domestic investors, we assume that the variation of each investor group's net worth can be proxied by the total GDP of the country, and replace their net worth N_t^i with $Y_{j,t}$ for each country j. By contrast, we treat the net worth of each of the foreign investor groups as a common group time fixed effect. Further, the impact on these investors of variations in global variables are subsumed by the time fixed effects. However, we return to discuss the effect of global financial variables below. Further, we assume the total GDP of the issuance country is included in the vector of $X_{j,t}$. For expositional convenience, we shift GDP to the left-hand-side of the regression and use it to scale the holding of sovereign debt. These assumptions lead to a common regression specification of equation (13).

$$\frac{H_{j,t}^i}{Y_{j,t}} = \beta_0^i + \beta_1^i \ln y_{j,t} + (\gamma^i)' \mathbf{X}_{j,t} + (\delta^i)' \mathbf{Z}_{j,t} + \gamma_j^i + \theta_t^i + \varepsilon_{j,t}^i, \tag{13}$$

Thus, the book value country j debt as a a Share of GDP that is held by group i depends upon investor fixed effects, β_0^i and γ_j^i, time fixed effects, θ_t^i, as well as the yield $y_{j,t}$, and country variables, $\mathbf{X}_{j,t}$ and $\mathbf{Z}_{j,t}$. For the analysis below, we use 5-year local currency government bond yield as the relevant price variable.[20]

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[19]See for example, Hau and Rey (2006), Maggiori et al. (2020), Coppola et al. (2021).

[20]We use five-year yields because the coverage of countries is greater than other maturities. Similarly, we use the yields in local currency since EM governments have been increasingly issuing debt in local currency, thereby

In order to determine appropriate country variables, we draw on a large literature on emerging market sovereign debt that has provided a rich set of variables that may impact investor demand. In general, creditors prefer a higher yield, but are concerned about potential default risk. Creditors are more likely to invest in countries with characteristics that they view as correlated with lower default. For example, they are likely to be attracted to countries with higher growth, but dislike currency depreciation.[21] We therefore consider a more general demand estimation using a number of characteristics variables, including real GDP growth ("GDP growth"), inflation, the logarithm of the export-to-GDP ratio ("Exp-to-GDP"), the local currency depreciation rate ("Depr. Rate"), and the share of sovereign bonds in the international market that is denominated in local currency ("LC share").

Estimating equation (13) directly is subject to an endogeneity problem that the yield can be correlated with the unobserved demand shock. This problem is standard in the demand estimation literature. (See, for example, Koijen and Yogo (2019) for a discussion as it relates to asset pricing.) Following Koijen and Yogo (2020), we use an identification strategy that exploits the market clearing condition in equation (12). The instrument construction follows three basic steps. First, we calculate the ex post market value of holdings by multiplying the book value times the price-to-book value realized in that period. Thus, the hypothetical market value of holdings by an investor group i becomes: $H_{j,t}^{i,m} = H_{j,t}^i / (1 + y_{j,t})^T$, where T equals the maturity of the debt in years and where the superscript of m indicates "market" value.

Using this constructed market value of holdings per investor group, we next estimate the demand for holdings as a reduced-form function of country characteristics $\tilde{X}_{j,t}$. The pseudo-demand by investor group i can then be estimated using the regression:

$$\ln \frac{H_{j,t}^{i,m}}{Y_{j,t}} = \alpha_0 + \alpha_1 \tilde{X}_{j,t} + \delta_j^i + \delta_t^i + u_{j,t}^i. \tag{14}$$

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making the liquidity in these markets greater. For discussion, see for example Du and Schreger (2016) and Table C4 in the BIS Debt Securities Statistics.

[21]See for example Arellano (2008) and Aguiar and Gopinath (2007) on output growth; Arellano et al. (2020) and Reinhart and Rogoff (2011) on inflation and depreciation. Aguiar, Chatterjee, Cole, and Stangebye (2020) provides a survey.

Then using the fitted value of this regression, $\ln\left(\frac{\hat{H}_{j,t}^{i,m}}{Y_{j,t}}\right)$, and imposing the hypothetical market clearing across investors that would hold for a country with these characteristics implies:

$$\sum_{i=1}^{I} \exp\left(\ln\frac{\hat{H}_{j,t}^{i,m}}{Y_{j,t}}\right) = \frac{D_{j,t}}{Y_{j,t}(1+\tilde{y}_{j,t})^T}. \tag{15}$$

This market clearing condition can then be used to solve for the hypothetical yield $\tilde{y}_{j,t}$ that clears the market given the implicit market demand and ex post market values. The hypothetical yield $\tilde{y}_{j,t}$ is then used as an instrument for the actual yield $y_{j,t}$ in the estimation.

As noted above, this instrument depends upon certain identifying assumptions. Importantly, the country-specific variables included in $\tilde{X}_{j,t}$ and the supply of debt-to-GDP are pre-determined to the investor decision. This assumption seems plausible on economic terms because the current period macroeconomic and financial variables are determined by the fundamentals of the country, rather than from the demand of investors. Moreover, the sovereign decides how much debt to issue to satisfy the government's budget constraint. We return to the relevance of this assumption below.

In addition, the instrument for the yield needs to be relevant. For this relevancy condition to hold, the instrument must be strongly related to the observed yield $y_{j,t}$ conditional on all the controls in the regression. To determine this relevance, we test our instrument using the weak first-stage IV test of Stock and Yogo (2005). With an F statistic exceeding 20, and thereby a level greater than the critical value of 16.38 at 10% level, we conclude that the relevance condition is satisfied.

Furthermore, to be valid, our instrument must pass the exogeneity condition. In particular, the instrument must be independent of sovereign debt holdings except through the yield and all other controls in the regression. As Equations (14) and (15) show, the constructed instrument is only a function of the set of predetermined characteristics $\tilde{X}_{j,t}$, fixed effects, and the book value of debt to GDP, $\frac{D_{j,t}}{Y_{j,t}}$. Therefore, the instrument only depends upon variables exogenous to the investor decision, and is not affected by an unobserved latent demand variable.

Table 3 in Panel A reports the IV estimation results, and we relegate the raw estimates to the Appendix D.1. As a first pass validity check, the response of investor demand to yield is positive and significant, consistent with standard economic theory. All investor groups increase holdings in response to a higher yield. Moreover, most investor groups increase demand for a country's sovereign debt when GDP grows, inflation declines, and exports increase, although insignificantly so for some groups. However, the impact of currency is more varied across investor groups, particularly for Non-Banks. Specifically, variation in the local currency denomination of internationally issued debt, "LC share", is insignificantly related to demand by domestic private investors, but reflects a decrease in demand by Foreign Non-Banks and Central Banks. Furthermore, in contrast to the other investment groups, Domestic Non-Banks increase holdings of sovereign debt with the currency depreciates. Again, these results point to an important role for Non-Banks as differentiated investor groups than the other creditors.

Table 3: Emerging Market Sovereign Debt Demand by Country Characteristics

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
	Panel A: IV Estimates					
Bond yield	0.082***	0.094***	0.024**	0.010*	0.114***	0.057***
	(0.023)	(0.029)	(0.012)	(0.005)	(0.030)	(0.018)
GDP growth	0.202	0.221	0.147**	-0.020	0.588***	0.117
	(0.139)	(0.171)	(0.071)	(0.032)	(0.177)	(0.109)
Inflation	-0.010	-0.128*	0.050*	-0.012	-0.058	-0.108**
	(0.058)	(0.071)	(0.030)	(0.013)	(0.074)	(0.046)
Exp-to-GDP	0.012	-0.012	0.005	0.002	0.082***	0.082***
	(0.022)	(0.027)	(0.011)	(0.005)	(0.028)	(0.017)
Depr. Rate	-0.077***	0.127***	-0.038***	-0.004	-0.031	-0.010
	(0.018)	(0.022)	(0.009)	(0.004)	(0.023)	(0.014)
LC share	-0.048	-0.029	-0.071***	-0.003	-0.169***	-0.070**
	(0.037)	(0.045)	(0.019)	(0.008)	(0.046)	(0.029)
Obs	339	339	339	339	339	339
	Panel B: Shares and Demand Elasticity					
Mean $\frac{H^i_{j,t}}{Y_{j,t}}$	0.128	0.156	0.029	0.020	0.068	0.070
Elasticity	0.641	0.603	0.826	0.50	1.676	0.814

Note: This table reports the IV estimates of the demand function in Equation (13), with the control of country and year fixed effects for the EM sovereign debt. The sample spans 1996-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. The standard errors clustered at country and year level are reported in the parentheses. Panel A reports the instrumental variable estimates. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Panel B gives the shares and implied demand elasticities.

The coefficient estimate for log yield in Panel A represents the slope of the "demand function" by capturing how desired investor holdings vary with the yield; that is, the inverse price. It will be useful in our borrowing exposure counterfactuals below to convert these estimates into a demand elasticity. For this purpose, we construct the sovereign debt

demand elasticities by investor group as reported in the Panel B.[22]

As the estimates show, the foreign Non-banks have the highest elasticity among the private investors at a value of 1.676, followed by domestic banks and non-banks, while foreign banks' elasticity of demand is the smallest. The official sector's demand elasticity lies between domestic private investors and Foreign Non-banks. The impact of each of these respective investor groups on total demand have strong implications for the vulnerability of sovereign borrowers, a point we discuss in the next section.

Since the global variables are common to all investors, their impacts are absorbed by the year fixed effects. In order to analyze more specifically the effects of these global variables, Appendix D.3 reports the regression results including two global financial variables: log VIX and the log of the broad dollar index. As articulated in a number of papers including Miranda-Agrippino and Rey (2021), the VIX may capture global risk aversion or investor sentiment. Moreoever, rises in the dollar value may generate binding financial constraints for global intermediaries exposed to many different currencies as describe in Bruno and Shin (2015), for example. Including these global effects in the regressions show that investor responses to yield changes are similar to the results in Table 3. Particularly, foreign nonbanks respond the most and foreign banks respond the least. In addition, however, a rise in VIX reduces all investor groups' holding of the EM sovereign debt while a stronger dollar is associated with an increase of EM debt holding for all investor groups. Overall, therefore, these findings are consistent with the general framework provided above.

3.3   Investor Demand for AE Sovereign Debt

We next apply this same demand analysis to investors in the advanced economy sovereign debt market. The methodology of estimating AE sovereign debt demand function is similar to EMs with two modifications. First, since AE sovereign debt is almost entirely issued in local currency, we drop the variable "LC share" from the country characteristics list of

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[22]Specifically, the elasticity is defined as: $\eta^i = \frac{d\left(H_j^i/Y_j\right)}{dy_j} \frac{y_j}{\left(H_j^i/Y_j\right)}$. For y_j and H_j^i/Y_j, we use the averages over time and country in the sample, as reported in the table.

regressors.[23] Second, given the special status of the US Treasury Market, we exclude the U.S. sovereign debt from the AE sample. Indeed, as is well recognized in the literature, US Treasuries are often treated as special safe assets in the international financial market.[24] This safe asset status has sometimes been described as an "exorbitant privilege."[25] Moreover, we exclude Greece for the period of 2009 to 2015, when Greece was experiencing a debt crisis and its yield was spiked to an excessively high level.

Table 4 reports the IV estimation results for AEs. The first-step regression for the instrument and the raw estimates are reported in Appendix D.4 and D.5.

Table 4: Advanced Economies Sovereign Debt Demand by Country Characteristics

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
Bond yield	0.016	0.179***	-0.009	0.000	0.139**	0.019
	(0.024)	(0.054)	(0.015)	(0.013)	(0.056)	(0.033)
GDP growth	-0.357*	0.383	0.158	-0.057	0.600	0.016
	(0.204)	(0.462)	(0.125)	(0.110)	(0.479)	(0.279)
Inflation	-0.041	0.325	0.345**	0.411***	-0.675	0.556
	(0.268)	(0.608)	(0.165)	(0.145)	(0.631)	(0.368)
Exp-to-GDP	0.151***	0.291***	0.140***	-0.066***	0.256***	0.135***
	(0.034)	(0.077)	(0.021)	(0.018)	(0.080)	(0.046)
Depr. Rate	0.004	0.139	0.040	0.006	0.080	0.009
	(0.041)	(0.094)	(0.025)	(0.022)	(0.097)	(0.057)
Obs	266	266	266	266	266	266
Panel B: Shares and Demand Elasticity						
Mean $\frac{H^i_{j,t}}{Y_{j,t}}$	0.154	0.227	0.040	0.066	0.151	0.098
Elasticity	NA	0.789	NA	NA	0.920	NA

Note: This table reports the IV estimates of the demand function in Equation (13), with the control of country and year fixed effects. The sample spans 2000-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. The standard errors clustered at country and year level are reported in the parentheses. Panel A reports the instrumental variable estimates. * p < 0.10, ** p < 0.05, *** p < 0.01. Panel B gives the shares and implied demand elasticities with "NA" when estimates are insignificant.

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[23]Unlike EM countries, this pattern has held for AE countries for several decades. For example, see the discussion in Eichengreen, Hausmann, and Panizza (2003).

[24]See for example, Jiang et al. (2018).

[25]See for example the discussion in Gourinchas, Rey, and Govillot (2017).

As the first row shows, the response of investor groups' holding to yield changes are mostly positive, except for the domestic central bank. However, unlike for the holdings of EM debt, only two out of six coefficients are statistically significant. These findings are consistent with the common view that the demand for AE sovereign debt is primarily for purposes related to liquidity and capital market regulation purposes. Indeed, a lower real GDP growth of the country depresses both domestic and foreign banking sectors' holdings. Domestic central banks and foreign banks increase holdings of debt issued by countries with higher inflation, although the major advanced economies have experienced relatively low inflation during the past three decades. A higher export-to-GDP ratio attracts all investors groups. Unlike for EM debt, investor demand for AE debt appears relatively insensitive to currency depreciation.

In Panel B of the Table, we report the sample average of holding to GDP by different investor groups, and the implied price elasticity of different investor groups. Similar to the EM sovereign debt, the Foreign Nonbank sector has the highest elasticity with respect to yield. But the Domestic Nonbank sector's demand elasticity is also much higher than investor groups. In general, the banking sector holds advanced economies' sovereign debt as safe and liquid assets to satisfy the liquidity requirement and the central banks hold these debt as foreign reserves. These narratives are consistent with our results that Banks and Central Bank holdings are insensitive to yield changes.

4   Borrower Country Exposure and Counterfactuals

Above, we have estimated demand functions of sovereign debt by investor groups. We now use these estimates to ask what they imply about the exposure that countries have to the implied costs of borrowing. This question is clearly an important one given the projected rise of debt-to-GDP in the next few years.

4.1 Borrowing Exposure Measure "Delta"

An economic entity's position in a given activity is often viewed as its exposure to that activity. For example, popular press accounts often describe the foreign currency revenues of a firm as its currency exposure. Similarly, others may look at the amount of investment in a country like Russia as a measure of exposure to a country or region. By contrast, the literature on economic risk exposure attempts to measure the underlying risks faced by an economic entity to these positions. According to this argument, measuring the nominal amount of a position does not provide a true picture of the risk an entity faces to position. For instance, a firm with a given level of foreign currency revenues may be very exposed to variations in the exchange rate or not at all depending upon how the overall profits of a firm are affected by exchange rate variation. This difference may depend upon whether the size of the currency revenues are small or large within the cash flows of the firm and whether the underlying position itself can act as a hedge to currency.[26] By a similar argument, the same size of investment in a country like Russia may signal a worrisome or insignificant level of exposure to a portfolio depending upon how well the portfolio is diversified overall.

For these reasons, a standard interpretation of true economic exposure to risks faced by an economic entity is to consider the sensitivity of the economic outcome to variations in the risky variable. Thus, this economic exposure measure can be measured as simply the percentage change in an outcome of concern as a result of a percentage change in the risky variable. Going back to the example of the currency risk of the firm, this measure is the percentage change in profits (or firm value) that would result from a percentage change in the exchange rate. For a portfolio invested in Russia, it would be the percentage change in the value of the portfolio for percentage change in the value of Russian investments. This measure has been used in a literature studying the risk faced by companies involved in international investment and trade. For example, Bartov and Bodnar (1994), Bodnar et al. (2002), and, more recently, Adams and Verdelhan (2021) study the exposure of firm profitability to

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[26]See, for example, Bodnar, Dumas, and Marston (2002) for more discussion.

currency.

In this paper, we are interested in the borrowing costs of the sovereign of a given country as the outcome of interest. Clearly then, the analysis above has shown that these borrowers face risks to their borrowing costs from the investor set. Thus, we can use the same approach to calculate the exposure a country faces to its borrowing costs. In this case, the exposure measure is the percentage change in borrowing costs due to a percentage change in shocks that would impact the country's need to borrow. Following the literature, we call this measure the Exposure Delta and for our application, more specifically, the Borrowing Exposure Delta. To see this exposure calculation, note that the present value of the cost of borrowing to the country is equal to the present value of debt to the creditors. Subsuming the dependence on characteristic variables for expositional simplicity, we can write the holdings of country j for each investor group i generally as $H^i_{j,t}$ and the price determined by the inverse demand function of these holdings as $P^i_j(H^i_{j,t})$. Then the accounting identity under market clearing implies:

$$D_{j,t}P_{j,t} \;=\; \sum_{i=1}^{I} H^i_{j,t} P^i_j(H^i_{j,t}) \tag{16}$$

We next use the fact that the price of debt is the discounted yield. As an approximation, we denote the yield corresponding to the inverse demand as $y^i_{j,t}$ in the the identity $P^i_{j,t} = 1/(1+y_{j,t})^T$, where $y^i_{j,t}$ is the yield faced by investor group i. Appendix E shows that the borrowing cost exposure, Exposure Delta, faced by country j is measured by:

$$\delta_{j,t} \equiv \frac{\partial y_{j,t}/y_{j,t}}{\partial d_{j,t}/d_{j,t}} = \sum_{i=1}^{I} \left(\frac{\partial y^i_{j,t}/y^i_{j,t}}{\partial d_{j,t}/d_{j,t}} \right) \frac{dH^i_j}{dD_j} \tag{17}$$

$$= \sum_{i=1}^{I} \left(\frac{a^i_j}{\eta^i_j} \right)$$

where η^i_j is the elasticity of demand by investor group i for sovereign debt for a country with the characteristics of country j and where a^i_j is the change in holdings by investor group i in response to changes in debt of country j. Thus, a country's financing exposure is a weighted

average of inverse demand elasticities η_j^i for each investor group, where the weights are the marginal financing-shares, $a_j^i \equiv \frac{dH_j^i}{dD_j}$. Therefore, the exposure measure can be constructed by combining the marginal investor responses in Section 2 with the investor elasticities from Section 3.

4.2 "Borrower Exposure Delta" and Counterfactuals: EM

The Exposure Delta measure provides a useful benchmark for understanding the underlying risk. For countries such as the U.S. with sovereign debt that is viewed by investors as a safe haven asset, the borrowing costs may be essentially unrelated to the size of borrowing deflated by GDP. Indeed, as we saw in Table 4, investors in AE debt are essentially unresponsive to yield, with the possible exception of the Non-banks. Therefore, these "safe asset" countries are likely to be relatively unexposed to higher costs due to expanding debt-to-GDP and thus $\delta_j = 0$. We therefore exclude AE country debt in these counterfactuals and focus instead on EM country debt. For countries with more risky debt, $\delta_j > 0$ since expanding debt creates a greater perception of default by investors, thereby requiring a higher yield to compensate. Nevertheless, if δ_j is less than one, then an increase in borrowing is related to an increase than is less than proportionate to that increase. However, if δ_j is greater than one a country faces an out-sized increase in borrowing costs in response to higher borrowing. Therefore, $\delta_j = 1$ provides a useful benchmark for the stability of a government's ability to respond to borrowing needs.

Table 5 shows these exposures using the Exposure Delta measure in equation (18). Panel A gives the measure for the total set of investor groups. The first two rows provide two useful Benchmarks. The first row notes that for a Safe Asset country, the Exposure Delta is likely near zero since the country can typically expand debt without meaningfully raising financing costs. By contrast, the second row gives the upper level of one as the Exposure Delta for which countries can expand debt without more than proportionally increasing costs.

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Table 5: Emerging Market Borrowing Exposures

Panel A: Total Borrowing Cost Exposure and Counterfactuals

		Delta
Benchmarks:		
	Safe asset	0.00
	Knife-edge high	1.00
Using Estimates:		
	Delta	1.38
	Without Domestic	0.89
	Without Official	1.38
	Without Non-banks	1.54

Panel B: Individual Investor Exposures

Marginal:	DomBank	Dom NonBnk	Dom Cen	ForBank	For NonBnk	For Cen
Exposures	1.56	1.66	1.21	2.00	0.60	1.23
Absorption	0.21	0.43	0.04	0.05	0.24	0.04
Excluding Group	1.32	1.15	1.37	1.33	1.61	1.37

Note: This table shows the exposure of the sovereign's financing cost to the increase in government debt. Delta corresponds to the exposure measure δ in Equation (18). Each row represents one counterfactual scenario.

The next row of Panel A provides the overall Borrowing Cost Exposure Delta estimates using the absorption shares reported in Table 1. The following rows illustrate the vulnerabilities of these countries to the presence of different investor groups. For these counterfactuals, the absorption shares of different investor groups are set to zero with the remaining shares distributed proportionately across the remaining investors according to their marginal absorption. As the counterfactuals show, excluding Domestic investors as a whole would move the Exposure Delta below one. By contrast, excluding the Non-bank investor groups

would significantly increase overall Exposure Delta above its base level to 1.5, higher than when we exclude official creditors.

Panel B of Table 5 explores the contribution of each investor group. For each of the six investor groups, the table first reports both the Marginal "Exposures" given by investor i as $1/\eta^i_j$. These numbers provide estimates for how sensitive the borrowing costs for EM governments would be if only one investor group provided the credit. Alternatively, the Marginal "Absorption" numbers indicate for the Baseline case how much debt each investor group takes on as a country's debt expands: $a^i_j \equiv \frac{dH^i_j}{dD_j}$. The last row measures the Exposure Delta under the counterfactual experiment that a given investor group absorbs no additional debt so that the other investors take the debt on.

As these numbers show, the EM borrowers' exposure to Foreign Non-Banks are the largest at 1.61. Indeed, in the case of Foreign Non-Banks, the high demand elasticity implies that having only these investors would generate a lower impact on borrowing cost exposure of only 0.60. Therefore, excluding these investors clearly leads to a higher overall exposure, 1.61, contributing to the overall sensitivity to Non-bank investors reported in Panel A. In general, if the Non-bank investor group were absent, the countries would face considerably more volatility in borrowing costs in response to changes in debt-to-GDP. Therefore, these counterfactuals suggest considerable exposure to Emerging Market sovereigns to the existing set of creditors, particularly Non-banks.

5 Concluding Remarks

The rising levels of government debt worldwide in the wake of the Covid-crisis have made urgent the answers to questions about their repayment. At the front of those questions is: who holds this debt and does it matter to borrowers in this market? In this paper, we address these questions by analyzing a unique data set that decomposes sovereign debt into investor holding groups for a large number of countries over almost three decades.

Based upon our analysis, the answers to these questions are striking. First, private finan-

cial institutions that are not banks absorb substantially more of the variation in outstanding government debt than other investor groups. Across all countries, they take up 69% on the margin of increases in the debt, although they only hold 46% on average. Further decomposing this Non-bank investment group using Euro Area data, we find that investment funds are the drivers of this larger group.

Second, total holdings of sovereign debt by each investor group responds strongly to global shocks. For example, when the dollar appreciates and world GDP grows, sovereign debt holdings generally decline. Furthermore, increases in uncertainty measured by the VIX growth rate leads to increases in holdings of AE government debt but decreases in decreases for EM sovereigns.

Next, we identify a demand function for EM investor groups by exploiting a feature of our data. In particular, our data provides the full set of investor groups by country allowing us to solve for the market clearing condition. Using these estimates, we find that the elasticity of demand by Non-bank foreign investors is higher than other groups.

Finally, we use both the marginal increase of holdings together with the investor demand estimations to calculate the implied government debt exposure. As we show, an average EM country faces significant borrowing exposure since a percentage increase in debt-to-GDP leads to a greater than proportional cost across existing investor groups. Even more remarkable, these countries face the greatest exposure against Non-bank investors compared to any other investment groups. We conclude that EM sovereign investors are highly vulnerable to Non-bank investors.

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A Data construction

The series in the aggregate dataset are sampled at an annual frequency, covering the years between 1990 and 2018. The series are denominated in US dollars.[27] Debt for each category refers to general government debt, which consists of state, local, and central government debt.

Total Total debt holdings are measured by combining the data from the IMF Historical Public Debt Database (debt-to-GDP) and GDP series from The World Bank. While a full data series over time are available for some, there are 96 countries for which the debt-to-GDP series ends in 2015.[28] For these countries, we forecast the total debt level using the forward-looking growth rates from QPSD total debt series in years 2016-2018.

Foreign Total The methodology for calculating foreign total holdings is based on that in Avdjiev et al. (2018). As a first step, these series are collected from the international investment position (IIP) dataset giving the sum of external portfolio debt liabilities and external other investment debt liabilities for the general government sector. When missing, these series are complemented with data from the Quarterly External Debt Statistics (QEDS) that provides the external debt of general government. The remaining missing values are filled by estimates derived from the BIS international banking statistics (IBS) and BIS international debt securities (IDS) datasets.

Foreign Official Foreign official holdings for advanced economies and China are taken from Arslanalp and Tsuda (2012) and Arslanalp and Tsuda (2014), consisting mostly of foreign official reserves held abroad. The remaining countries are populated with the data from the

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[27]Series that are originally reported in local currency are converted to US dollars using the end of period exchange rate from the IMF. Robustness to currency value effects are described in Section B.2

[28]Afghanistan, Algeria, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Azerbaijan, Bahamas, Bahrain, Belize, Benin, Bermuda, Bhutan, Bolivia, Botswana, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Cameroon, Cayman Islands, Central African Republic, Chad, Comoros, Republic of Congo, Cote d'Ivoire, Curacao, Djibouti, Dominica, Ecuador, Republic of Equatorial Guinea, Eritrea, Eswatini, Gabon, Gambia, Ghana, Grenada, Guinea, Guinea-Bissau, Guyana, Haiti, Hong Kong SAR, Iran, Iraq, Jamaica, Jordan, Kenya, Kuwait, Lao People's Democratic Republic, Lesotho, Liberia, Libya, Liechtenstein, Macao SAR, Madagascar, Malawi, Maldives, Mali, Mauritania, Morocco, Mozambique, Myanmar, Namibia, Nepal, New Zealand, Niger, Oman, Pakistan, Papua New Guinea, Qatar, Rwanda, Samoa, San Marino, São Tomé and Príncipe, Saudi Arabia, Senegal, Sierra Leone, Singapore, Solomon Islands, South Africa, Sri Lanka, Sudan, Suriname, Syrian Arab Rep., Togo, Tonga, Trinidad and Tobago, Tunisia, Uganda, Uruguay, Vanuatu, Venezuela, Zambia, Zimbabwe.

World Bank debtor reporting system (DRS) data on bilateral and multilateral official lending to emerging and developing economy governments.

Foreign Bank The methodology for estimating foreign bank holdings is based on Avdjiev et al. (2018). We compute estimates for share of official holdings from international claims in the Consolidated Banking Statistics (CBS) and apply that share to cross-border bank lending from the Locational Banking Statistics (LBS). In addition, we make a correction for Switzerland where holdings by external banks are significantly overestimated with our methodology.[29]

Foreign Nonbank The Foreign Nonbank series is computed by subtracting Foreign Official and Foreign Bank series from the Foreign Total.

Domestic Total Domestic Total series is computed by subtracting Foreign Total from the Total.

Domestic Central Bank For the most part, domestic central bank holdings are taken from the IMF's International Financial Statistics (IFS) data set. This data base provides the debt holdings levels from the Standardized Reporting Form (SRF) only from 2001 onwards. Therefore, debt holding levels prior to 2001 are backcasted with annual growth rate taken from the non-standardized reporting form (non-SRF) in the same dataset. For the countries where the IFS data was incomplete, additional data was taken from the official websites of respective central banks.[30] For these cases, the IFS data was supplemented using the backward-looking growth rates taken from central banks' websites.[31]

Domestic Bank These holdings were compiled using the same procedure as for Domestic Central Bank.

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[29]Specifically, the ratio from consolidated banking statistics (CBS) is close to 30% around 2014, while updated data from the locational banking statistics (LBS), which includes a sector breakdown for government lending in recent years, suggests the true ratio is closer to 10%, but not more than 20%.

[30]Austria, Belgium, Bulgaria, Finland, France, Germany, Greece, Iceland, Ireland, Korea, Latvia, Portugal, Spain, Sweden, UK.

[31]The list of countries for which additional data from the official Central Bank websites was used: Belgium, Finland, France, Germany, Korea, Luxembourg, Mexico, Netherlands, Portugal, Serbia, Spain, Sweden.

Domestic Nonbank The Domestic Nonbank series were computed by subtracting the Domestic Central Bank and Domestic Bank series from the Domestic Total.

Inconsistencies and Cleaning When combining data across different sources, inconsistencies are inevitable. While most of the dataset fits together, there are some cases where the sum of some of the components (e.g. domestic central bank and domestic bank) add to more than the total (e.g. domestic total). In these cases, the procedure produces some negative observations for residually computed groups (e.g. domestic non-banks). In general, we used the following procedures to maintain internal consistency in the dataset (i.e. the sum of the parts add up to the whole) for these special cases.

If the Foreign Official plus Foreign Bank is greater than the Foreign Total, we replaced the Foreign Total as the sum of the Foreign Bank plus the Foreign Official; that is, replace Foreign = max(Foreign total, foreign official + foreign bank).

If the sum of the Foreign total and the Domestic bank and the Domestic Central Bank is greater than the total debt, we replace total debt as this sum; that is, replace Total debt = max(Total debt, foreign total + domestic bank + domestic Central Bank)

Given these updated variables, we compute any residual categories as needed; that is, we would subtract the other variables from the updated totals to measure the Foreign Non-bank, the Domestic Total, and the Domestic Non-bank.

After following this process, all of the generated data series are greater than or equal to zero, and the data are internally consistent. Further, we manually examine cases where the negative values were large to make sure that this procedure made sense. In a few cases where it appears driven by low data quality, we replace the observation with linear interpolation.

B   Additional Results

This appendix provides more detailed results and robustness checks for the analysis in Section 2.3.

B.1   Marginal Holders under Different Circumstances

B.1.1   Recessions and Non Recessions

This subsection reports the regression results depicted in Figures 2.

Table B1: Marginal Holders of Sovereign Debt: Recession and No Recession

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
				Panel A: Recessions				
All	0.83***	0.17***	0.08	0.75***	0.00	-0.05	0.19**	0.03
	(0.05)	(0.05)	(0.05)	(0.09)	(0.01)	(0.04)	(0.09)	(0.03)
AE	0.68**	0.32	0.01	0.63**	0.05*	-0.10	0.70***	-0.28
	(0.26)	(0.26)	(0.09)	(0.23)	(0.02)	(0.11)	(0.21)	(0.20)
EM	0.82***	0.18	-0.02	0.87***	-0.03	-0.02	0.14	0.05
	(0.13)	(0.13)	(0.06)	(0.16)	(0.02)	(0.04)	(0.14)	(0.05)
DC	0.67***	0.33*	0.07	0.46*	0.14	-0.01	0.19**	0.15**
	(0.18)	(0.18)	(0.10)	(0.22)	(0.09)	(0.08)	(0.08)	(0.06)
				Panel B: Non Recessions				
All	0.60***	0.40***	0.17***	0.37***	0.05***	0.05***	0.30***	0.05***
	(0.05)	(0.05)	(0.04)	(0.06)	(0.02)	(0.02)	(0.05)	(0.01)
AE	0.54***	0.46***	0.02	0.41***	0.11	0.05**	0.34***	0.07**
	(0.11)	(0.11)	(0.03)	(0.09)	(0.07)	(0.02)	(0.10)	(0.03)
EM	0.67***	0.33***	0.25***	0.37***	0.05**	0.07***	0.24***	0.01
	(0.05)	(0.05)	(0.05)	(0.08)	(0.02)	(0.02)	(0.06)	(0.01)
DC	0.50***	0.50***	0.10***	0.35***	0.05***	0.02	0.38***	0.11***
	(0.09)	(0.09)	(0.02)	(0.08)	(0.02)	(0.02)	(0.09)	(0.03)

Note: This table reports the regression coefficients for Equation (4) for each investor group with a balanced sample during recessions (Panel A) and non recessions (Panel B). A recession is defined as a negative real GDP growth rate. Country and year FEs are included, and standard errors are clustered at the country level and reported in the parentheses. Columns (1) and (2) represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups.

B.1.2 Banking Crisis and No Banking Crisis

Table B2: Marginal Holders of Sovereign Debt: Banking Crisis and No Banking Crisis

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
			Panel A: Banking Crisis					
All	0.69***	0.31***	0.06	0.56***	0.07	0.02	0.21**	0.09
	(0.05)	(0.05)	(0.05)	(0.07)	(0.06)	(0.02)	(0.09)	(0.06)
AE	0.72***	0.28	-0.09*	0.52***	0.29**	0.08*	0.17	0.03
	(0.19)	(0.19)	(0.05)	(0.12)	(0.11)	(0.04)	(0.25)	(0.05)
EM	0.65***	0.35***	0.09*	0.56***	0.01	0.00	0.26**	0.09
	(0.07)	(0.07)	(0.04)	(0.07)	(0.01)	(0.02)	(0.10)	(0.07)
DC	0.46***	0.54***	0.13*	0.31**	0.02	-0.00	0.42**	0.12*
	(0.12)	(0.12)	(0.06)	(0.13)	(0.02)	(0.01)	(0.17)	(0.07)
			Panel B: No Banking Crisis					
All	0.59***	0.41***	0.18***	0.37***	0.04***	0.05***	0.32***	0.04***
	(0.05)	(0.05)	(0.04)	(0.06)	(0.01)	(0.01)	(0.05)	(0.01)
AE	0.47***	0.53***	0.04*	0.41***	0.02**	0.06*	0.46***	0.01
	(0.12)	(0.12)	(0.02)	(0.11)	(0.01)	(0.03)	(0.11)	(0.03)
EM	0.67***	0.33***	0.24***	0.39***	0.04**	0.06***	0.25***	0.01
	(0.06)	(0.06)	(0.05)	(0.08)	(0.02)	(0.02)	(0.05)	(0.01)
DC	0.49***	0.51***	0.11***	0.34***	0.05**	0.01	0.40***	0.09***
	(0.11)	(0.11)	(0.04)	(0.10)	(0.02)	(0.02)	(0.11)	(0.02)

Note: This table reports the regression coefficients for Equation (4) for each investor group with a balanced sample during times with banking crises (Panel A) and without banking crisis (Panel B). A country-year i, t observation is defined as if country i experienced a banking crisis in either of year $t, t-1, t-2, t-3$. Banking crisis definitions follow Laeven and Valencia (2020). For the developing countries, the definition of crisis includes not only banking crisis, but also debt crisis and currency crisis. Country and year FEs are included, and standard errors are clustered at the country level and reported in the parentheses. Columns (1) and (2) represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups.

B.1.3 Different Subperiods

Table B3: Marginal Holders of Sovereign Debt: Different Subperiods

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
				Panel A: Before 2000				
All	0.57***	0.43**	0.11*	0.41**	0.05*	-0.01	0.42**	0.02
	(0.18)	(0.18)	(0.06)	(0.18)	(0.02)	(0.03)	(0.16)	(0.01)
EM	0.66**	0.34	0.06	0.50*	0.11***	0.03	0.31	-0.01
	(0.25)	(0.25)	(0.04)	(0.25)	(0.03)	(0.04)	(0.27)	(0.02)
DC	0.52*	0.48*	0.14*	0.35	0.02	-0.04	0.50**	0.02*
	(0.25)	(0.25)	(0.08)	(0.25)	(0.02)	(0.04)	(0.22)	(0.01)
				Panel B: 2000-2009				
All	0.52***	0.48***	0.15**	0.32***	0.05***	0.03	0.40***	0.05**
	(0.07)	(0.07)	(0.06)	(0.08)	(0.02)	(0.02)	(0.08)	(0.02)
AE	0.48***	0.52***	-0.01	0.38***	0.11	0.04*	0.46**	0.02
	(0.17)	(0.17)	(0.03)	(0.13)	(0.08)	(0.02)	(0.18)	(0.01)
EM	0.64***	0.36***	0.21**	0.40***	0.03*	0.04	0.28***	0.04
	(0.08)	(0.08)	(0.08)	(0.12)	(0.02)	(0.04)	(0.08)	(0.03)
DC	0.34**	0.66***	0.12	0.18*	0.04*	0.00	0.57***	0.09**
	(0.12)	(0.12)	(0.07)	(0.10)	(0.02)	(0.01)	(0.15)	(0.04)
				Panel C: After 2009				
All	0.72***	0.28***	0.17***	0.50***	0.05*	0.06***	0.17***	0.05**
	(0.04)	(0.04)	(0.04)	(0.08)	(0.03)	(0.01)	(0.03)	(0.02)
AE	0.61***	0.39***	0.11*	0.47***	0.03	0.06*	0.22**	0.11
	(0.10)	(0.10)	(0.05)	(0.09)	(0.02)	(0.03)	(0.08)	(0.09)
EM	0.73***	0.27***	0.23***	0.46***	0.05	0.07***	0.19***	0.01
	(0.05)	(0.05)	(0.05)	(0.10)	(0.03)	(0.01)	(0.05)	(0.01)
DC	0.73***	0.27**	0.04	0.60***	0.09	0.04	0.11*	0.12**
	(0.10)	(0.10)	(0.04)	(0.16)	(0.06)	(0.04)	(0.06)	(0.05)

Note: This table reports the regression coefficients for Equation (4) for each investor group with a balanced sample before 2000 (Panel A), 2000-2009 (Panel B), and after 2009 (Panel C). Country and year FEs are included, and standard errors are clustered at the country level and reported in the parentheses. Columns (1) and (2) represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups.

B.2 Marginal Investors Considering Currency Valuation Effect

This section reports regression results of Equation (6). As described in the text, these estimates incorporate the currency valuation effect on sovereign debt holdings by foreigners. As the estimates show, Domestic and Foreign Nonbanks continue to respond the most to variations in the supply of debt.

B.2.1 Unconditional Estimates

Table B4: Marginal Holders of Sovereign Debt

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
All	0.70***	0.30***	0.17***	0.46***	0.07***	0.03***	0.23***	0.04***
	(0.05)	(0.05)	(0.03)	(0.05)	(0.02)	(0.01)	(0.04)	(0.01)
AE	0.60***	0.40***	0.05**	0.46***	0.09	0.06**	0.31**	0.03
	(0.12)	(0.12)	(0.02)	(0.10)	(0.06)	(0.02)	(0.12)	(0.02)
EM	0.76***	0.24***	0.21***	0.47***	0.07***	0.04**	0.18***	0.03
	(0.05)	(0.05)	(0.04)	(0.06)	(0.02)	(0.01)	(0.04)	(0.02)
DC	0.60***	0.40***	0.11***	0.43***	0.05***	0.01	0.31***	0.07***
	(0.10)	(0.10)	(0.04)	(0.09)	(0.01)	(0.01)	(0.10)	(0.02)

Note: Panel A of the table reports the regression coefficients for Equation (6) for each investor group. The first two columns represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups. Standard errors clustered at the country level are reported in the parentheses. Panel B of the table reports the average share of holding by each investor group.

B.2.2 Recessions and Non-Recessions

Table B5: Marginal Holders of Sovereign Debt: Recession and Non Recession

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
				Panel A: Recessions				
All	0.89***	0.11**	0.17***	0.63***	0.09***	-0.01	0.11**	0.01
	(0.05)	(0.05)	(0.04)	(0.05)	(0.03)	(0.02)	(0.05)	(0.02)
AE	0.86***	0.14	0.01	0.81***	0.04	-0.08	0.40	-0.18
	(0.25)	(0.25)	(0.08)	(0.24)	(0.02)	(0.08)	(0.27)	(0.15)
EM	0.85***	0.15*	0.16***	0.56***	0.13**	0.02	0.09	0.03
	(0.07)	(0.07)	(0.04)	(0.07)	(0.04)	(0.02)	(0.07)	(0.03)
DC	0.82***	0.18	-0.07	0.78***	0.10	-0.03	0.13	0.08
	(0.17)	(0.17)	(0.09)	(0.23)	(0.07)	(0.08)	(0.10)	(0.08)
				Panel B: Non Recessions				
All	0.67***	0.33***	0.17***	0.44***	0.06***	0.05***	0.24***	0.04***
	(0.05)	(0.05)	(0.03)	(0.06)	(0.01)	(0.01)	(0.05)	(0.01)
AE	0.62***	0.38***	0.07***	0.45***	0.10	0.05**	0.28**	0.05*
	(0.11)	(0.11)	(0.02)	(0.09)	(0.07)	(0.02)	(0.10)	(0.03)
EM	0.73***	0.27***	0.22***	0.45***	0.06***	0.06***	0.19***	0.01*
	(0.06)	(0.06)	(0.05)	(0.09)	(0.02)	(0.02)	(0.05)	(0.01)
DC	0.60***	0.40***	0.12***	0.42***	0.05***	0.02	0.30***	0.08***
	(0.10)	(0.10)	(0.04)	(0.08)	(0.02)	(0.01)	(0.09)	(0.02)

Note: This table reports the regression coefficients for Equation (6) for each investor group with a balanced sample during recessions (Panel A) and non recessions (Panel B). A recession is defined as a negative real GDP growth rate. Country and year FEs are included, and standard errors are clustered at the country level and reported in the parentheses. Columns (1) and (2) represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups.

B.2.3 Banking Crisis and No Banking Crisis

Table B6: Marginal Holders of Sovereign Debt: Banking Crisis and No Banking Crisis

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
				Panel A: Banking Crisis				
All	0.83***	0.17**	0.13***	0.58***	0.12***	0.00	0.12*	0.05
	(0.07)	(0.07)	(0.04)	(0.04)	(0.04)	(0.02)	(0.07)	(0.04)
AE	0.85***	0.15	0.06**	0.53***	0.26***	0.07**	0.04	0.03
	(0.13)	(0.13)	(0.03)	(0.07)	(0.07)	(0.03)	(0.16)	(0.03)
Obs	64	64	64	64	64	64	64	64
r2	0.88	0.55	0.38	0.87	0.77	0.44	0.33	0.40
EM	0.82***	0.18	0.16**	0.54***	0.13***	-0.01	0.15	0.04
	(0.11)	(0.11)	(0.06)	(0.06)	(0.04)	(0.01)	(0.10)	(0.04)
DC	0.65***	0.35**	0.05***	0.59***	0.02	0.01	0.25*	0.08**
	(0.12)	(0.12)	(0.01)	(0.12)	(0.02)	(0.01)	(0.13)	(0.04)
				Panel B: No Banking Crisis				
All	0.67***	0.33***	0.18***	0.44***	0.05***	0.04***	0.25***	0.03***
	(0.05)	(0.05)	(0.03)	(0.06)	(0.01)	(0.01)	(0.05)	(0.01)
AE	0.53***	0.47***	0.03	0.48***	0.01*	0.07**	0.40***	0.01
	(0.12)	(0.12)	(0.02)	(0.12)	(0.01)	(0.03)	(0.11)	(0.03)
EM	0.73***	0.27***	0.22***	0.45***	0.06***	0.05***	0.20***	0.02*
	(0.05)	(0.05)	(0.04)	(0.08)	(0.02)	(0.02)	(0.05)	(0.01)
DC	0.57***	0.43***	0.13**	0.39***	0.05***	0.01	0.34***	0.08***
	(0.12)	(0.12)	(0.05)	(0.10)	(0.01)	(0.02)	(0.12)	(0.02)

Note: This table reports the regression coefficients for Equation (6) for each investor group with a balanced sample during times with banking crises (Panel A) and without banking crisis (Panel B). A country-year i, t observation is defined as if country i experienced a banking crisis in either of year $t, t-1, t-2, t-3$. Banking crisis definitions follow Laeven and Valencia (2020). For the developing countries, the definition of crisis includes not only banking crisis, but also debt crisis and currency crisis. Country and year FEs are included, and standard errors are clustered at the country level and reported in the parentheses. Columns (1) and (2) represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups.

B.2.4 Different Subperiods

Table B7: The Marginal Holder of Sovereign Debt: Different Subperiods

	(1) Dom	(2) For	(3) DomBK	(4) DomNB	(5) DomCB	(6) ForBK	(7) ForNB	(8) ForCB
				Panel A: Before 2000				
All	0.60***	0.40**	0.07**	0.47***	0.06*	-0.01	0.41**	0.01
	(0.16)	(0.16)	(0.03)	(0.17)	(0.03)	(0.03)	(0.15)	(0.01)
EM	0.63**	0.37	0.10*	0.42*	0.11***	0.03	0.36	-0.01
	(0.22)	(0.22)	(0.05)	(0.24)	(0.04)	(0.03)	(0.24)	(0.02)
DC	0.57**	0.43*	0.06*	0.48*	0.02	-0.04	0.44*	0.03*
	(0.24)	(0.24)	(0.03)	(0.23)	(0.02)	(0.03)	(0.21)	(0.01)
				Panel B: 2000-2009				
All	0.65***	0.35***	0.18***	0.41***	0.06***	0.03*	0.28***	0.04**
	(0.07)	(0.07)	(0.04)	(0.07)	(0.02)	(0.02)	(0.07)	(0.02)
AE	0.58***	0.42**	0.03	0.46***	0.10	0.05**	0.36**	0.01
	(0.16)	(0.16)	(0.02)	(0.11)	(0.07)	(0.02)	(0.17)	(0.01)
EM	0.73***	0.27***	0.23***	0.44***	0.06**	0.03	0.20***	0.03
	(0.08)	(0.08)	(0.06)	(0.09)	(0.03)	(0.03)	(0.07)	(0.02)
DC	0.52***	0.48***	0.15**	0.33***	0.04**	0.01	0.41**	0.07*
	(0.16)	(0.16)	(0.06)	(0.11)	(0.01)	(0.01)	(0.17)	(0.03)
				Panel C: After 2009				
All	0.80***	0.20***	0.16***	0.56***	0.07***	0.04***	0.13***	0.03**
	(0.05)	(0.05)	(0.04)	(0.07)	(0.02)	(0.01)	(0.03)	(0.01)
AE	0.68***	0.32***	0.13*	0.55***	0.01	0.05	0.17*	0.10
	(0.11)	(0.11)	(0.07)	(0.11)	(0.02)	(0.03)	(0.09)	(0.08)
EM	0.82***	0.18***	0.20***	0.54***	0.08***	0.04***	0.13***	0.01
	(0.06)	(0.06)	(0.04)	(0.09)	(0.03)	(0.02)	(0.05)	(0.01)
DC	0.76***	0.24**	0.04	0.64***	0.08	0.05	0.10*	0.09*
	(0.09)	(0.09)	(0.03)	(0.14)	(0.05)	(0.03)	(0.06)	(0.05)

Note: This table reports the regression coefficients for Equation (6) for each investor group with a balanced sample before 2000 (Panel A), 2000-2009 (Panel B), and after 2009 (Panel C). Country and year FEs are included, and standard errors are clustered at the country level and reported in the parentheses. Columns (1) and (2) represent domestic and foreign investors, respectively. Columns (3) through (8) correspond to the six investor groups.

C The Supply Function of Debt

Government borrowers provide the "supply" of sovereign debt. Although this statement is clearly true in general, it will prove convenient to illustrate the relationship in the context of the emerging market debt literature. In this literature beginning with Eaton and Gersovitz (1981) and adapted by Arellano (2008), the government conducts all borrowing for the economy. Under the additional assumption that all debt is one period, the government solves the optimization problem taking the debt pricing schedule $q_j(B_{j,t})$ as given:

$$\max_{C_{j,t}, B_{j,t}} \sum_{t=0}^{\infty} \beta^t E u(c_{j,t}) \tag{18}$$

$$C_{j,t} + B_{j,t-1} = Y_{j,t} + q_j(B_{j,t}) B_{j,t} \tag{19}$$

where for country j, $C_{j,t}$ and $Y_{j,t}$ are consumption and output, respectively, and where $B_{j,t}$ is an internationally traded pure discount bond and $q_j(B_{j,t})$ is the price schedule of the bond. Although this relationship holds generally, we assume that the price schedule is independent of investors' demand shocks for our empirical implementation. As in Arellano and Ramanarayanan (2012), we can also extend this framework to allow for longer term coupon debt. For example, Bai, Kehoe, and Perri (2019) generalize this relationship by specifying that the government pays out existing debt as a coupon payment given by: ϕB_t for the first period, $\phi(1-\phi)B_t$ for the second period, $\phi(1-\phi)^2 B_t$ for the third period, etc. This stylized approach includes as special cases the one period debt above as $\phi = 1$ and, on the other extreme, a perpetuity as $\phi = 0$. In this case, the budget constraint becomes:

$$C_{j,t} = Y_{j,t} + q_j(B_{j,t}) B_{j,t} - [q_j(B_{j,t})(1 - \phi_j) + \phi_j] B_{j,t-1} \tag{20}$$

Thus, consumption is income $Y_{j,t}$ net of paying current borrowing obligations from the prior period $\phi_j B_{t-1}^j$ and rolling over next period debt with new borrowings, $B_{j,t} - (1 - \phi_j) B_{j.t-1}$ at price $q_j(B_{j,t})$. More generally, allowing for investment, government spending, and net exports, the basic balance of payments identity in equation (20) can be generalized to include investment and government spending. For this more general aggregate budget constraint, we

can redefine C as domestic absorption and recognize that net current account balances equal the change in the value of bond holdings. We use Export-to-GDP as a proxy for this relationship in our empirical estimates.

The solution to the government's optimization problem implies that the supply of sovereign debt depends upon a number of country-specific macroeconomic variables that we define as a vector process at time t as: $\mathbf{X}_{j,t}$. In particular, this set of variables is a vector of country-specific characteristics that may impact the desire to borrow, including the growth rate of the economy, η_t, and prior sovereign debt-to-output share d_{t-1}.

Another set of variables that impact sovereign debt supply relates to the price of borrowing and the characteristics of these obligations. Clearly, the supply of debt depends negatively upon the direct cost of borrowing. To make clear the special role of borrowing costs, we separate out yield $y_{j,t}$ from the debt characteristic vector $Z_{j,t}$ in the text.

In addition, however, borrowing may entail indirect costs if the debt must be repaid in foreign currency or at undesirable maturity durations. Indeed, recent literature has argued that domestic sovereigns preferred to borrow in their own local currencies rather than foreign currency borrowing that entails greater exchange rate risk.[32] Similarly, countries may face a trade-off of lower borrowing costs in short term maturities that incur greater roll-over risk versus a higher cost of borrowing long term.[33] We combine these direct and indirect costs of borrowing in a vector of debt characteristics defined as: $\mathbf{Z}_{j,t}$. Thus, this vector includes, indirect costs such as a disadvantageous maturity of debt $\phi_{j,t}$, a higher share of debt denominated in foreign currency, and a higher value of foreign currency that impacts that share.

Overall these basic relationships can be then summarized in a general supply of debt-to-GDP relationship given by equation (10) in the paper and repeated here for convenience:

$$d_t \equiv d(\mathbf{X}_{j,t}; \mathbf{Z}_{j,t})$$

That is, the share of government debt to output depends upon a vector of country-specific macro-economic variables, $\mathbf{X}_{j,t}$, and debt characteristics, $Z_{j,t}$. Then, the supply of debt by

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[32]See for example Ottonello and Perez (2019), Arellano et al. (2020), and Du, Pflueger, and Schreger (2020).
[33]See Arellano and Ramanarayanan (2012) for a development of this argument.

country can be written as in equation (11) of the paper as in:

$$D_{j,t} \equiv d(\mathbf{X}_{j,t}; \mathbf{Z}_{j,t}) Y_{j,t}$$

Clearly, these relationships reflect basic borrowing functions that map the country-specific variables and their debt characteristics into the supply of debt. In our analysis, we plausibly assume that the supply of debt is predetermined in the beginning of the period in which investors extend credit.

D   Additional Results for Investor Demand

D.1   Reduced-form Estimates of IV Construction: EMs

This section reports the regression coefficients for the first-stage regression that constructs the instrument.

Table D8: Reduced-form regression for the instrument: EM

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
GDP Growth	0.56	-3.86	2.96	-2.75	1.92	-1.82
	(1.04)	(2.27)	(2.77)	(1.92)	(2.12)	(1.97)
Inflation	-1.65***	0.26	-0.44	-2.19***	0.93**	-0.56
	(0.49)	(0.44)	(1.14)	(0.37)	(0.35)	(0.36)
Exp-to-GDP	0.11	-0.16	-0.37	0.11	0.98*	0.68*
	(0.22)	(0.25)	(0.56)	(0.37)	(0.54)	(0.40)
Obs	406	367	339	406	353	396
R2	0.86	0.82	0.71	0.84	0.78	0.88

Note: This table reports the reduced-form estimates of the first-stage regression of instrument construction for EMs, with the control of country and year fixed effects. The sample expands 1996-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. The standard errors clustered at country and year level are reported in the parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.2   Raw Estimates of Demand Estimation: EM

Table 3 in the text provides the IV estimates of demand for investors in EM sovereign debt. Below we report the raw estimates of investor holding on log yield and other controls. As

these estimates show, the responses of yield generally have the wrong signs are and mostly insignificant, which reflects the potential omitted variable bias and the necessity of employing the instrumental variable strategy..

Table D9: Raw Estimates of Investor Demand: EM

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
Bond yield	-0.017***	-0.001	-0.002	0.003	-0.006	0.012
	(0.005)	(0.007)	(0.007)	(0.003)	(0.014)	(0.012)
GDP_growth	-0.183***	-0.057	0.003	-0.022	0.081	-0.119
	(0.061)	(0.108)	(0.049)	(0.016)	(0.140)	(0.090)
Inflation	0.052	-0.024	0.071**	0.004	0.018	-0.043
	(0.048)	(0.048)	(0.028)	(0.014)	(0.045)	(0.044)
Exp-to-GDP	-0.007	-0.028	-0.012	-0.005	0.035	0.040
	(0.031)	(0.039)	(0.020)	(0.008)	(0.032)	(0.036)
Depr. Rate	-0.052**	0.144***	-0.028***	-0.008*	-0.003	-0.010
	(0.020)	(0.024)	(0.008)	(0.004)	(0.018)	(0.009)
LC share	0.010	0.045***	-0.073**	-0.010	-0.131	-0.083
	(0.043)	(0.016)	(0.030)	(0.006)	(0.102)	(0.057)
Observations	363	363	363	363	363	363

Note: This table reports the reduced-form estimates of equation (13). The sample expands 1996-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. Standard errors clustered at the country and year level are reported in the parenthese. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.3 Including Global Financial Variables: EM

Table D10: IV Estimates Book Value

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
Bond yield	0.093***	0.070**	0.037***	0.010*	0.191***	0.101***
	(0.031)	(0.028)	(0.014)	(0.005)	(0.051)	(0.027)
GDP growth	0.044	0.081	0.096	-0.012	0.499**	0.076
	(0.132)	(0.119)	(0.061)	(0.023)	(0.217)	(0.113)
Inflation	-0.110	-0.129*	0.010	-0.005	-0.308**	-0.179**
	(0.084)	(0.076)	(0.038)	(0.015)	(0.138)	(0.072)
Exp-to-GDP	0.084**	0.038	0.019	-0.001	0.189***	0.110***
	(0.034)	(0.031)	(0.016)	(0.006)	(0.056)	(0.029)
Depr. Rate	-0.060***	0.142***	-0.035***	-0.009**	-0.009	-0.019
	(0.021)	(0.019)	(0.010)	(0.004)	(0.035)	(0.018)
LC share	-0.004	0.023	-0.084***	-0.006	-0.153**	-0.109***
	(0.047)	(0.042)	(0.021)	(0.008)	(0.077)	(0.040)
VIX	-0.048***	-0.041***	-0.005	-0.005**	-0.070***	-0.025**
	(0.014)	(0.012)	(0.006)	(0.002)	(0.022)	(0.012)
Dollar	0.222***	0.143***	0.084***	0.019**	0.328***	0.186***
	(0.053)	(0.048)	(0.025)	(0.009)	(0.088)	(0.046)
Obs	342	342	342	342	342	342

Note: This table reports the instrumental variable estimates of equation (13) with the inclusion of the two global financial variables, log VIX and log broad dollar index with country fixed effect. The sample expands 1996-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. Standard errors clustered at the country and year level are reported in the parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

D.4 IV Construction: AE

Table D11: Reduced-form regression for the instrument in log: without global variables

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
GDP growth	-1.13	-7.48***	-3.35	-0.43	-2.13	1.08
	(1.28)	(1.48)	(3.94)	(1.18)	(1.87)	(1.27)
Inflation	-0.78	-0.06	13.97**	8.24***	-1.72	1.53
	(2.06)	(2.38)	(6.42)	(1.89)	(2.98)	(2.61)
Exp-to-GDP	1.33***	0.66**	5.89***	-0.81***	0.71*	-0.41
	(0.25)	(0.30)	(0.80)	(0.23)	(0.37)	(0.25)
Obs	374	355	344	375	357	350
r2	0.99	0.81	0.75	0.80	0.71	0.87

Note: This table reports the reduced-form estimates of the first-stage regression of instrument construction for AEs, with the control of country and year fixed effects. The sample expands 1996-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. The standard errors clustered at country and year level are reported in the parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.5 Raw Estimates: AE

Table D12: Raw Estimates Book Value: Level without global variables

	(1) DomBK	(2) DomNB	(3) DomCB	(4) ForBK	(5) ForNB	(6) ForCB
Bond yield	0.015*	0.023***	-0.012*	-0.015***	-0.020	0.047*
	(0.008)	(0.006)	(0.006)	(0.005)	(0.013)	(0.027)
GDP growth	-0.218*	-0.450**	0.064	-0.083	-0.209	-0.369
	(0.108)	(0.171)	(0.120)	(0.083)	(0.189)	(0.391)
Inflation	-0.090	0.514	0.572	0.383**	-0.425	-0.011
	(0.280)	(0.573)	(0.358)	(0.144)	(0.410)	(0.318)
Exp-to-ratio	0.104**	0.126**	0.137***	-0.093**	0.067	0.387
	(0.048)	(0.057)	(0.025)	(0.038)	(0.117)	(0.239)
Depr. Rate	-0.011	0.101*	0.013	-0.014	-0.038	0.108
	(0.027)	(0.057)	(0.024)	(0.021)	(0.045)	(0.070)
Obs	337	337	337	337	337	337

Note: This table reports the reduced-form estimates of equation (13). The sample expands 1996-2018 at annual frequency. The dependent variable is holding of the group indicated in the column title to GDP. Standard errors clustered at the country and year level are reported in the parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E   Exposure

This section provides the detailed algebra that yields Equation (18) in the main text.

The exposure analysis is based on the following equation:

$$P_{j,t}D_{j,t} = \sum_{i=1}^{6} P_{j,t}^i H_{j,t}^i$$

where $P_{j,t}^i$ is the price faced by investor i. In equilibrium $P_{j,t} = P_{j,t}^i$ for all i. For ease of notation, we write $P_{j,t} = \exp(-y_{j,t})$ and $P_{j,t}^i = \exp(-y_{j,t}^i)$ and abstract away the maturity. Therefore,

$$y_{j,t} = -\ln D_{j,t}^{-1} - \ln \sum_{i=1}^{6} \exp(-y_{j,t}^i) H_{j,t}^i$$

Thus:

$$\frac{dy_{j,t}}{dD_{j,t}} = \frac{1}{D_{j,t}} - \frac{1}{\sum_{i=1}^{6} \exp(-y_{j,t}^i)H_{j,t}^i} \left[\sum_{i=1}^{6} \frac{d\left(\exp(-y_{j,t}^i)H_{j,t}^i\right)}{dH_{j,t}^i} \frac{dH_{j,t}^i}{dD_{j,t}} \right]$$

Let investor group i's marginal financing share $\frac{dH_{j,t}^i}{dD_{j,t}} = a_j^i$ and $\frac{dH_{j,t}^i}{dy_{j,t}^i} \frac{y_{j,t}^i}{H_{j,t}^i} = \eta_j^i$.

$$\frac{dy_{j,t}}{dD_{j,t}} = \frac{1}{D_{j,t}} - \frac{1}{\sum_{i=1}^{6} \exp(-y_{j,t}^i)H_{j,t}^i} \left[\sum_{i=1}^{6} a_j^i \left(\exp(-y_{j,t}^i) - H_{j,t}^i \exp(-y_{j,t}^i) \frac{1}{\eta_j^i} \frac{y_{j,t}^i}{H_{j,t}^i} \right) \right]$$

We define exposure δ_j as

$$\delta_j = \frac{dy_{j,t}}{dD_{j,t}} \frac{D_{j,t}}{y_{j,t}} = \frac{1}{y_{j,t}} - \frac{1}{y_{j,t} \sum_{i=1}^{6} \exp(-y_{j,t}^i)\frac{H_{j,t}^i}{D_{j,t}}} \left[\sum_{i=1}^{6} a_j^i \exp(-y_{j,t}^i) - a_j^i \exp(-y_{j,t}^i)y_{j,t}^i \frac{1}{\eta_j^i} \right]$$

Plug in $y_{j,t}^i = y_{j,t}$, $\sum_{i=1}^{6} a_j^i = 1$, and $\sum_{i=1}^{6} H_{j,t}^i = D_{j,t}$, we obtain Equation (18).

$$\delta_j = \frac{dy_{j,t}}{dD_{j,t}} \frac{D_{j,t}}{y_{j,t}} = \sum_{i=1}^{6} \frac{a_j^i}{\eta_j^i}.$$

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