Loanly Governments:
Sovereign Debt in the Wake of Credit Rating Downgrades

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Abstract

This paper studies the funding structure of governments, examining financing beyond traditional sovereign bond markets. We document significant heterogeneity in the use of bonds and loans, and in the composition of foreign and domestic creditors. We relate this heterogeneity to sovereign credit ratings and present three key findings. First, sovereigns adjust the composition of financing instruments when credit ratings change. Second, not all rating changes and countries are alike. We find strong evidence for substitution from bonds to loans only when (i) credit ratings decrease for (ii) countries that have been rated sufficiently low. Third, the substitution toward loans is primarily financed through the domestic financial sector via foreign funds, and associated with a subsequent increase in financial distress, raising financial stability concerns. Finally, we show that the documented loan-bond substitution is also accompanied by a reduction in real GDP, primarily driven by a decline in investment, suggesting real adverse consequences.

Keywords: Government debt, Sovereign bond markets, Loans, Credit ratings

JEL classification codes: F34, G15, G24, H63

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1. Introduction

Sovereigns use government debt to finance public infrastructure investment, cope with macroeconomic crises, and smooth taxes over time. To raise the needed capital, most advanced economies resort to the issuance of sovereign bonds, a financing instrument which critically depends on creditworthiness, as indicated by sovereign credit ratings (e.g., Reinhart et al., 2003; Romer and Romer, 2019). Government bond issuance also provides liquid assets to the economy, which are particularly important for the financial sector that holds these assets to manage risk, to pledge as collateral, or to comply with other regulatory requirements (e.g., Krishnamurthy and Vissing-Jorgensen, 2012). In general, however, government debt does not necessarily have to be a liquid asset if the government does not issue bonds but finances itself via loans. But do advanced economies use such loans from financial intermediaries? If so, when and where are they issued, and who are the ultimate creditors providing funding?

We are the first to address these questions, whereas prior literature has focused almost exclusively on government financing via bonds or on government debt in its entirety, without distinguishing between instruments (see, e.g., Mitchener and Trebesch, 2021).[1] We find an average loan-to-GDP ratio of 14% across space and time for our sample of 33 advanced economies between 1970 and 2018. Furthermore, guided by a simple conceptual framework of sovereign finances, we document significant heterogeneity in the use of bonds and loans, and in the composition of foreign and domestic creditors. We relate this heterogeneity to sovereign credit ratings and present three key findings. First, sovereigns adjust the composition of financing instruments when credit ratings change. Second, not all rating changes and countries are alike. We find strong evidence for substitution from bonds to loans only when (i) credit ratings decrease for (ii) countries that have been rated sufficiently low. Third, the substitution toward loans is primarily financed through the domestic financial sector via foreign funds, and associated with a subsequent increase in financial distress, raising financial stability concerns. Finally, we show that rating decreases for sufficiently low-rated countries, and the accompanying loan-bond substitution, are also followed by a reduction in real GDP, primarily due to a decline in investment, suggesting real adverse consequences.

Crucial to our analysis are two levels of data that we collect for an unbalanced panel of 33 advanced economies from 1970 to 2018. First, we use sovereign credit ratings from the four leading rating agencies: Fitch, S&P, Moody's, and DBRS Morningstar. Based on this, we build a composite

[1] A few papers have focused on development loans, most notably with the rise of China as an international creditor (Horn et al., 2021; Gelpern et al., 2023). Instead, we are the first to raise the above questions for advanced economies.

rating index leveraging the fact that all ratings are on a comparable scale. To validate our rating index, we compare it with ten-year sovereign bond yields. Reassuringly, we confirm a strong inverse correlation when accounting for global time trends. Second, we use the financial accounts of the OECD, originally collected by Diebold and Richter (2021) and extended in Castells-Jauregui et al. (2024) for flow-of-funds data. These data show that, on average across the entire sample, government loans amount to 14% of GDP. This masks important variation across space and time. The relative importance of loans decreased between 1970 and the Global Financial Crisis in 2008, corresponding to the spread and internationalization of bond markets. After the crisis, this trend reversed, with loans increasing in importance during the following decade. Similar variation exists across countries, with the United States having virtually no loans, while Japan and some European countries finance themselves with loans to a considerable degree.

Building on the "unveiling" methodology introduced by Mian et al. (2020) and further developed by Diebold and Richter (2021), we show that for both instruments, loans and bonds, foreign holders have taken an increasingly important role. While this trend is stronger for bonds, we find especially loans to be increasingly financed indirectly through the domestic financial sector. This development may have adverse consequences: It raises the risk of being exposed to future financial turmoil, as capital supply from international investors tends to be volatile and prone to flight risk (Forbes and Warnock, 2012; Broner et al., 2013). This may be especially relevant when foreign capital is used to finance increasingly less liquid domestic assets (Calvo, 1998; Diebold and Richter, 2021).

We connect these developments in sovereign financing with the governments' creditworthiness, as measured by our credit rating index. To guide the analysis, we present a simple framework of government finances. In this model, the government acquires a certain amount of funds by choosing the amount of loans and bonds that minimizes interest rate expenses. Interest rates on bonds increase as a sovereign's credit rating deteriorates due to a reduced liquidity premium of holding these assets. Because of this (convex) relation, the government substitutes away from bonds and toward loans in response to a rating downgrade. Moreover, the model delivers the testable prediction that a decrease in the credit rating has a larger impact than an equally sized increase, with this difference being more pronounced for a sovereign with low initial rating. Intuitively, this formalizes the idea that highly rated countries experience only small changes in bond yields due to a rating change, whereas comparatively low-rated countries are hit by investors flight-to-safety behavior when their rating further deteriorates (e.g. Baele et al., 2020; Kekre and Lenel, 2024).

We empirically assess the model's prediction that credit rating downgrades lead to substitution

away from bonds toward loans, especially for countries with low (initial) rating levels. We implement this via an indicator variable specification that isolates the differential impact of credit rating downgrades for countries with below-average credit rating scores. After such downgrades, we find that ten-year sovereign bond yields to be differentially elevated. This effect is highly statistically significant and accompanied by an equally significant substitution away from government bonds and toward loans. Interestingly, the decrease in bond issuance is almost perfectly offset by the increase in loan issuance, suggesting almost perfect substitution. This is confirmed when looking at the overall government debt level, which tends to be unresponsive.[2] These patterns are quantitatively relevant, as the amount of substituted credit exceeds three percent of GDP, whereas bond yields increase by more than one percentage point over the five-quarter period under consideration. All of these findings are in line with the theoretical prediction outlined above.

The changing liability composition of governments implies a changing asset composition for other agents in the economy that act as creditors to the government. To understand these developments, we leverage our "unveiled" data that inform us about direct and ultimate creditors.[3] These data reveal that the decline in bond issuance (after downgrades for below-average rated countries) is associated with a statistically significant reduction in direct bond holdings by both domestic financial institutions and foreign investors. At the same time, the domestic financial sector increases its government loan holdings. Attributing these financial sector holdings to ultimate creditors, we find that government loans are increasingly financed by foreign capital. These effects are statistically significant and economically large. The financial sector's increase in loan holdings amounts to 2.5% of GDP, of which 0.8% is financed via domestic households and 1.5% indirectly via foreign investors. Including their direct holdings, foreign investors finance additional government loans worth 2.6% of GDP. These numbers imply a considerable increase in volatile foreign financing in the wake of credit downgrades for countries rated below average.

The increase in loan exposure on the asset-side among the sectors that provide funds to the government can be conveniently summarized by the ratio of loan holdings relative to bond holdings, the loan-bond ratio. To investigate implications for financial stability, we relate this loan-bond ratio to future financial distress, as measured by Romer and Romer (2017). Our results indicate that an

[2]Importantly, overall debt may still respond to unconditional downgrades (or upgrades) in the credit rating. However, considering downgrades, we find that the differential effect for below-average-rated countries is not accompanied by higher debt-to-GDP. Moreover, our results are not driven by asset valuation changes since we use issuance (flow-of-funds) data.

[3]Direct creditors hold government debt directly on their balance sheet, whereas ultimate creditors further include those that finance the government by financing intermediary corporations, which in turn hold government debt (see, e.g., Mian et al., 2020).

increase in the loan-bond ratio is followed by a statistically significant increase in financial distress, especially when considering the loan-bond ratio of government liabilities ultimately financed by the foreign sector. This reinforces the financial stability concerns that the foreign financing of government loans raises.

Given that government loan-bond substitution and the associated increase in financial distress is pervasive, we finally study the implications for the real economy. Our results indicate a statistically significant contraction in real GDP following credit rating downgrades for below-average rated countries. This contraction is primarily driven by lower real private investment. The effects are economically large. After around two years, we find cumulative real GDP growth to be ten percent lower. While year-over-year GDP growth might return to the pre-downgrade rate, there is a permanent level-shift in GDP. Similar patterns have been documented around the Great Financial Crisis for the United States and the European Union (e.g., Benigno and Fornaro, 2018).

Lastly, to address the challenge that rating downgrades could be anticipated, we propose a new measure of credit rating surprises as an instrumental variable, inspired by the identification approach that Romer and Romer (2004) apply to monetary policy interest rate changes. While the instrumental variable successfully eliminates pre-trends, we find that the estimated effects are similar in magnitudes and statistical significance compared with our baseline results. Therefore, we conclude that anticipation bias may be quantitatively negligible.[4]

Contribution to the literature. This paper makes four key contributions, which we describe vis-à-vis the existing literature. The first strand of literature empirically investigates general trends in government finances; see Mitchener and Trebesch (2021) for an overview. Recent advances in data availability allow for the analysis of government debt in developing countries at the instrument level (e.g., Mihalyi and Trebesch, 2022), but little research exists for advanced economies. For advanced economies, the literature generally focuses on bonds (e.g., Meyer et al., 2022), or considers government liabilities as a whole. Beyond bonds, Fang et al. (2025) study total government debt, including loans, but do not discriminate between instruments. Relative to these papers, our first key contribution is the analysis of government loans, bonds, and their holders in one coherent accounting framework. Along with our analysis, we provide a comprehensive dataset of government debt by funding instruments that is complete and not polluted by leakage, i.e., our data include all

[4]Recall that the reported estimates correspond to credit downgrades for below-average rated countries. We only claim that anticipation does not meaningfully alter these differential effects. The effects of credit rating downgrades, without conditioning on below-average rated countries, may still be contaminated by anticipation, as we discuss in section 4.

government debt on the liability side of the government and on the asset side of all (other) sectors. Finally, our data also include an allocation of government debt to ultimate counterparties, again, distinguishing between loans and bonds.

Second, we relate to the literature on the determinants of government borrowing. Romer and Romer (2019) emphasize the role of access to sovereign bond markets for governments' ability to raise funding for countercyclical policy measures. In a similar vein, Reinhart et al. (2003) and Reinhart and Rogoff (2009) emphasize the importance of the default history. Furthermore, an interesting and potentially overlooked point was made by Reinhart et al. (2003) who argue that it is especially (developing) countries with a low debt tolerance and low demand from international investors that resort to loans, because they "only have sporadic opportunities to borrow". As our second contribution, we investigate to which extent we observe similar patterns for advanced economies, capturing debt tolerance by our newly constructed sovereign credit rating index. To the best of our knowledge, we are the first to show that credit rating downgrades are followed by pervasive substitution from bonds to loans, especially for sufficiently low-rated countries. Interestingly, this aligns well with the finding that bond yields respond disproportionally strong to credit rating changes for countries that are rated poorly (Cantor and Packer, 1996).

Further related is the literature that focuses on rating agencies and sovereign credit ratings more generally, documenting home bias (Fuchs and Gehring, 2017), rating quality and competition (Becker and Milbourn, 2011), and implications for firm borrowing (Almeida et al., 2017). A comprehensive survey is provided by Panizza et al. (2009).

Third, we contribute to the literature examining financial stability through the lens of balance sheet risk of financial intermediaries. A large body of research has studied the provision of safe assets by sovereigns, which are often used by financial institutions for risk management or as collateral (Greenwood et al., 2015; Krishnamurthy and Vissing-Jorgensen, 2015). Several papers have documented a prolonged increase in demand for these assets, driven by a "savings glut" among agents with excess capital (Bernanke, 2005; Summers, 2014; Mian et al., 2020). However, this growing demand has not been matched by a corresponding increase in the supply of safe assets, which has remained relatively stable (Gorton et al., 2012; Castells-Jauregui et al., 2024), leading to a secular decline in interest rates for safe assets. We contribute to this literature by showing that a decrease in credit ratings for sufficiently low-rated countries is followed by a sharp increase in government bond yields. This development is accompanied by a reduction in the issuance of liquid assets (bonds) and an increasing issuance of less liquid assets (loans) by sovereigns. The simultaneous

substitution from more to less liquid assets on the balance sheets of financial intermediaries is followed by heightened financial distress. This effect is especially pronounced when less liquid assets on financial intermediaries' balance sheets are increasingly financed by more volatile foreign capital. These findings also relate to Jordà et al. (2016), who show that the banking sector is more vulnerable to adverse financial shocks when the sovereign's borrowing capacity is constrained.

Fourth and finally, our findings also contribute to the literature on the real economic costs of adverse financial shocks (e.g., Caldara et al., 2016; Benigno and Fornaro, 2018). Our finding of a slowdown in GDP growth following credit downgrades for countries with sufficiently low ratings aligns well to the finding of Palmén (2020), who shows that declining sovereign creditworthiness contributed to a fall in private lending during the Euro Crisis. This is consistent with our result of investment being the GDP component with the largest drop after credit rating downgrades.

2. Data construction and descriptive evidence

In the following section, we describe the construction of the data and discuss trends in sovereign credit ratings and the liability structure of governments for our sample of advanced economies. We document secular trends in credit ratings and government bond yields, which are negatively correlated after accounting for time trends. Moving to the liability structure of the government, we find that a substantial portion of government debt consists of loans, and that loan and bond issuance tend to be negatively correlated. Lastly, for both credit instruments, we "unveil" the ultimate financiers of government debt.

2.1. Data sources

Our two main data sources, which we will link in the following empirical sections, are newly compiled government credit ratings, and the OECD financial accounts. The latter contains the issuance, as well as the existing stock of government debt by credit instrument. Following the methodology of Mian et al. (2020) and Diebold and Richter (2021), these data allows us to "unveil" the ultimate creditors of government debt. Below, we provide a descriptive analysis of these data.

We further supplement our main data with economic forecasts for GDP growth, CPI inflation, and the current account from the World Economic Outlook of the IMF, and the financial distress index from Romer and Romer (2017). Finally, we also use conventional macroeconomic data, including ten-year sovereign bond yields, CPI inflation, and real GDP, as well as its sub-components. Table A1.1 in the appendix provides an overview of our sample coverage for these variables and

for each country in our sample. Overall, we have an unbalanced panel of 33 advanced economies covering the period from 1970 to 2018.

2.2. Sovereign credit ratings

Rating index construction. We collect the majority of sovereign credit ratings from World Government Bonds Credit Ratings (2024), and, in the case of missing entries, supplement it using Trading Economics (2024) and the websites of Fitchs (2024); Moodys (2024); Standard and Poors (2024); DBRS (2024).[5] Originally at daily frequency, we aggregate these ratings to quarterly observations to better match the frequency of our other data. Specifically, we always choose the rating valid at the end of each quarter. A commonality among the rating schemes of all four agencies is that they offer the same number of distinct rating categories.[6] This similarity offers a natural way of aggregating all four ratings into a compound rating index, since all ratings can be ranked on a numerical scale from 0 to 32. Figure A1.1 in the appendix exemplifies this for the United States, showing its ratings and the different scales of the four agencies as of November 2024.

To obtain a composite rating index, we map the ratings on a numerical scale for each rating agency. Ratings for governments in default are coded as 0. The lowest non-default rating is coded as 1, which, e.g., in the case of S&P corresponds to "C" with a negative outlook. It increases to 1.5 for a stable outlook and to 2, for "C" with a positive outlook. Afterwards, each rating step has three potential sub-steps: negative, stable, and positive outlook. Each improvement sub-step increases our rating variable by 0.5. This implies that the top rating is coded as 32.[7] The other rating agencies use comparable scales, as illustrated in Figure A1.1 Employing this rating-coding approach, we can compute the average rating across agencies for each country and quarter. Throughout the paper we will refer to this average rating as the rating index.

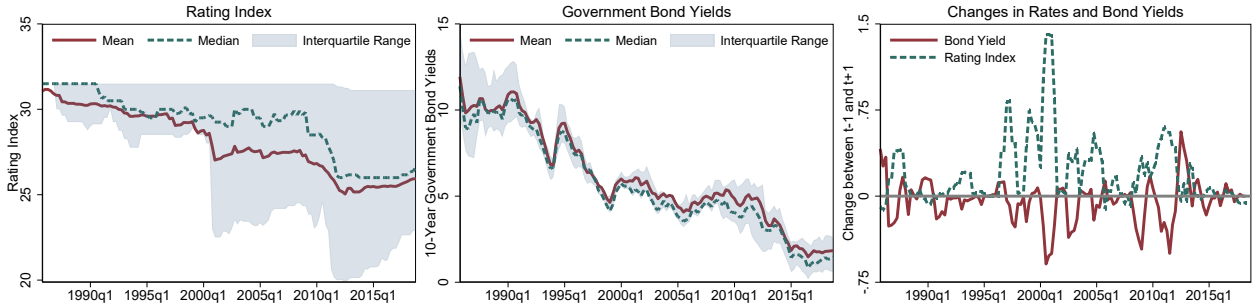
Descriptive evidence. The left panel of Figure 1 displays the mean, median, and interquartile range of our quarterly rating index between 1985 and 2018. The figure reveals a secular downward trend in sovereign credit ratings that holds for both, the median and average rating. This decline is partly driven by the inclusion of additional countries with lower credit scores and partly by

[5]We include these rating agencies as the only ones classified as External Credit Assessment Institutions (ECAI) by the EBA (European Banking Authority, 2018), coinciding with them having the largest market shares of all rating agencies.

[6]Labels may differ across agencies to, e.g., reflect different corporate styles. Yet, the individual labels are remarkably close: For example, the current (end of May 2025) U.S. rating of S&P, Moody's, and Fitch is the second best rating on their individual rating scales and the labels are "AA+", "Aa1", and "AA+", respectively.

[7]The different rating steps for, e.g., S&P are: C, CC, CCC-, CCC, CCC+, B-, B, B+, BB-, BB, BB+, BBB-, BBB, BBB+, A-, A, A+, AA-, AA, AA+ and AAA. Figure A1.1 illustrates this for S&P and the rating steps of the other agencies.

Figure 1: *Government credit ratings and government bond yields*



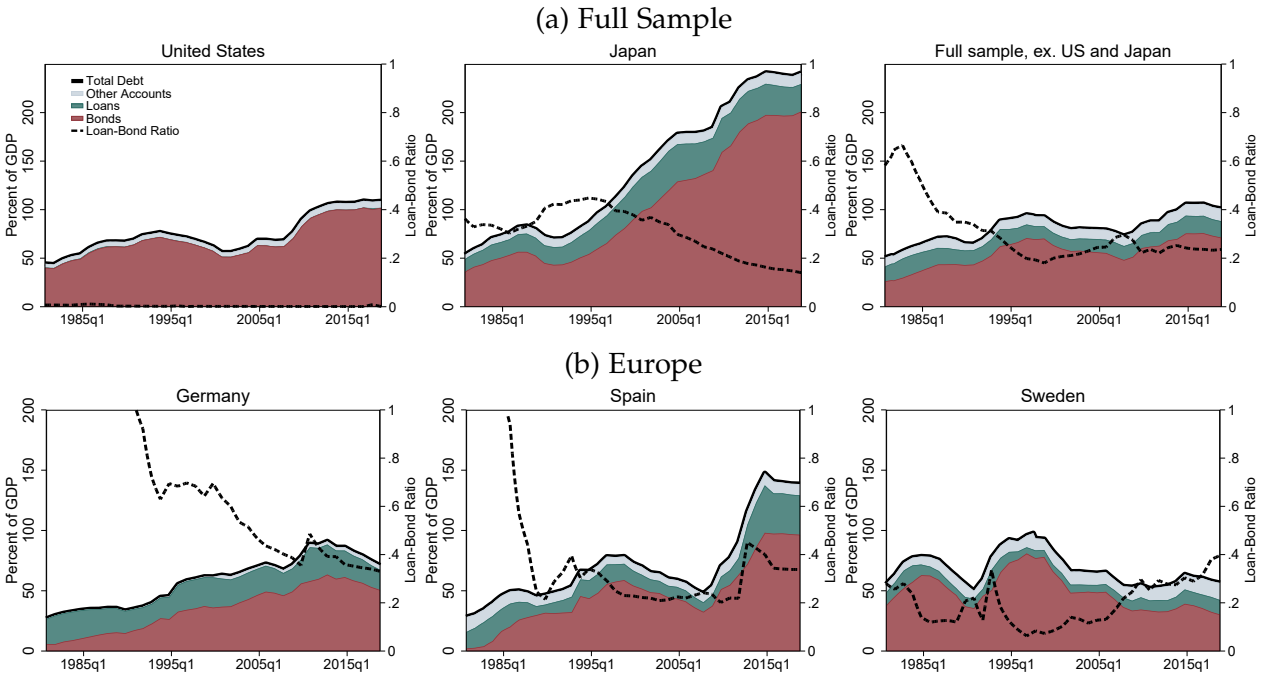
Notes: This figure shows government credit ratings and government bond yields between 1985 and 2018 for our unbalanced sample of advanced economies. The left panel displays the sample average and median of our credit rating index in red (solid line) and green (dotted line), respectively. Shaded areas represent the interquartile range. The middle panel presents the same three statistics, mean, median, and interquartile range, for ten-year government bond yields for the same set of observations. The right panel removes time trends by residualizing both series with respect to time fixed effects and plots one-year changes in the residualized series between $t-2$ and $t+2$, in red (solid line) for bond yields and green (dotted line) for the rating index.

downgrades within the existing sample, especially around and after the 2001 and 2007 financial crisis periods. Notably, these credit rating changes are concentrated among countries in the lowest quartile of the rating index, as the upper bound of the interquartile range (the third quartile) remains relatively stable throughout the sample.

The middle panel displays the average ten-year government bond yield for the same set of observations (i.e., where both ratings and yields are available). Despite notable fluctuations over the business cycle, these yields exhibit a similar long-term downward trend. This secular trend in bond yields aligns well with a large literature documenting long-term declines in interest rates (Holston et al., 2017; Rogoff et al., 2024), particularly for safe assets (Caballero et al., 2017; Del Negro et al., 2019). As might be expected, this trend partially reverses around the 2008 financial crises and the subsequent euro crisis, but resumes afterward.

The observed (unconditional) positive correlation between average credit ratings and average bond yields may reflect other macroeconomic trends that drive down bond yields, regardless of credit ratings. For example, this can be due to increased supply of funds, often referred to as savings glut (Bernanke, 2005; Summers, 2014; Mian et al., 2020). To take out such confounding trends, we residualize both series with respect to time fixed effects and show the one-year change between $t-2$ and $t+2$ using the residualized variables in the right panel of Figure 1. This reveals that fluctuations of bond yields and credit ratings around their respective trends are negatively correlated, as one would expect. This motivates us to study the link between credit ratings, associated yield changes and the funding structure of governments, which we discuss next.

Figure 2: *Government debt by country*



Notes: This figure shows the stock of government debt relative to GDP, broken down by financing instrument, between 1980 and 2018 for selected countries. Panel (a) displays series for the United States, Japan, and a sample average excluding the United States and Japan. Panel (b) presents series for Germany, Spain, and Sweden. Across panels, government bond liabilities are shown in red (bottom area), liabilities in the form of loans in green (middle area), and other instruments in gray (top area). The solid black line indicates the total amount of government liabilities relative to GDP. The dotted black line shows the loan-bond ratio on a secondary vertical axis on the right and capped at a maximum value of one.

2.3. Loans and bonds across space and time

Our data on government liabilities consists of two parts, which come from the OECD's financial accounts, and contain annual sectoral balance sheets and annual transacation values (Flow of Funds Data) by instrument. This data has initially been collected by Diebold and Richter (2021) and, for Flow of Funds data, been expanded by Castells-Jauregui et al. (2024). We linearly interpolate these data to quarterly frequency to match the frequency of the remaining data.

Government debt over time. Figure 2 shows the development of government liabilities, decomposed by financing instrument, relative to GDP over time. The top row displays the United States, Japan, and an average of all other sample countries. The bottom row depicts selected European countries. All panels show bond liabilities in red (lower area), liabilities in the form of loans in green (middle area), and other accounts in gray (top area). The dotted black line additionally shows the loans divided by bonds, the loan-bond ratio, on a secondary vertical axis on the right.

For the United States, government liabilities consist exclusively of bonds throughout the entire sample. In Japan, however, loans account for between 20% and 40% of total liabilities over our

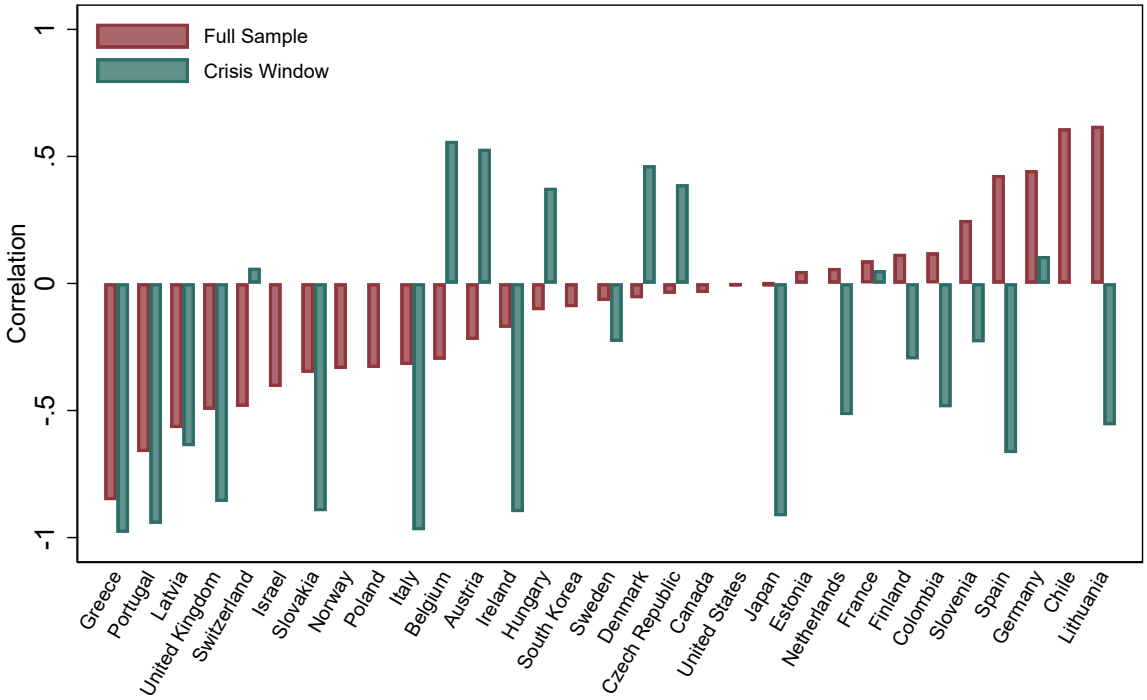
sample period, with a notable increase in both total liabilities (relative to GDP) and the share of loans (relative to bonds) following the Japanese Financial Crisis in the early 1990s. Over the subsequent three decades, the loan-bond ratio declined to its lowest point, around 15%, by the end of our sample in 2018. For the rest of the world (shown in the third panel), loans have comprised a relatively stable share of about 20% of government debt since the late 1990s, following a period of rapid decline. Notably, around the Great Financial Crisis, the loan-bond ratio temporarily increased for about two years before reverting to previous levels. The general trend away from loan financing, particularly during the early part of our sample, is consistent with the global development of government bond markets (Baker et al., 2021; OECD Global Debt Report, 2024), and with structural reforms that enabled governments to shift from relationship-based financing to market-based funding (De Broeck et al., 1998).

The second row takes a closer look at a set of European countries, showing government liabilities for Germany, Spain, and Sweden. The loan-bond ratio is capped at unity to ensure visibility of fluctuations at lower levels in the later part of the sample. For Germany and Spain, the share of loans relative to total debt declined rapidly during the initial decades of the sample. This trend is driven less by a contraction in loans and more by a consistent increase in bond debt, while loan debt relative to GDP remained relatively stable. In both countries, we observe an increase of loans relative to bonds during the Euro Crisis, as indicated by the uptick in the loan-bond ratio. This uptick is stronger and more persistent in Spain, which was directly affected by the crisis that unfolded from 2010 onward. In Sweden (right panel), loans are generally less important. However, the figure shows a marked spike in the loan-bond ratio during the Scandinavian Financial Crisis in the early 1990s. There is also a considerable upward trend in this ratio beginning with the Great Financial Crisis in 2008, even though total debt relative to GDP remains largely unchanged. Interestingly, this increase in the loan-bond ratio is highly persistent and continues until the end of our sample in 2018.

To further investigate the relationship between government bonds and loans, especially around periods of financial turmoil, we move to the second component of the OECD financial accounts and look at the transactions in bonds and loans on the government's liability side. This "flow" data captures the change in government liabilities due to transactions (excluding valuation changes or maturing securities), effectively representing the new issuance of debt.[8] Concretely, Figure 3

[8]In the OECDs financial accounts, yearly flows are described as the *net* in a sectors asset or liability position due to transaction. An intuitive way to think about is that a sector might both purchase and sell assets in the same period, only the difference of which is considered a change in its asset position due to transactions.

Figure 3: *Country-level correlation coefficients between bond and loan issuance*



Notes: This figure shows the Pearson correlation coefficient between new bond and loan issuance for all countries in our sample. Red bars represent the correlation over the entire sample period. Green bars indicate the correlation within a three-year window following a systemic banking crisis, as dated by Laeven and Valencia (2020). Countries are sorted based on the size of the correlation coefficient over the full sample period.

displays the Pearson correlation coefficient between bond and loan issuance across our entire sample in red (left bars). Additionally, as green bars on the right, we show the same correlation coefficient for a three-year window after systemic banking crises episodes, as dated by Laeven and Valencia (2020). Across the entire sample, about two-thirds of the countries exhibit a negative correlation, with considerable dispersion across countries. When looking at the immediate aftermath of financial crises, however, we find that more correlation coefficients become negative.

Relative to the coefficients estimated across the whole sample, correlations also become substantially larger in absolute value after financial crises. This may point to a higher degree of substitution between bonds and loans following episodes of financial distress. A few countries, however, display a positive correlation coefficient between loans and bonds, even in the aftermath of financial crises. Interestingly, the majority of these countries were rated very highly at the beginning of the Great Financial Crisis (Austria, Belgium, Denmark, France, Germany, and Switzerland), suggesting that the degree of loan-bond substitution could relate to the level of the credit rating.[9]

[9]The only countries that do not fit this observation are Hungary and the Czech Republic.

2.4. Unveiling the holders of loans and bonds

Unveiling approach. In addition to the stock of government debt by instrument, the OECD's financial accounts also contain the financial balance sheets of all other sectors in the economy (households, non-financial corporations, the financial sector, the government, and the rest of the world). In the financial accounts, assets and liabilities at the instrument level perfectly match each other. This allows us to build on the "unveiling" methodology introduced by Mian et al. (2020) and further developed by Diebold and Richter (2021) to determine the direct and ultimate counterparties holding government debt.

In short, this process involves the proportional allocation of sectoral liabilities to the assets of all other sectors at the instrument level. While bonds, and especially loans, are often held as assets by financial intermediaries, the intermediaries are not the ultimate counterparties providing financing. Instead, intermediaries may finance their assets with, for example, deposits, bonds, equity, etc., on the liability side of their balance sheets. Thus, an intermediary's assets are ultimately financed by the sectors that hold its liabilities as assets on their own balance sheets. Following Mian et al. (2020), we assume that ultimate financing sectors (u) can only be domestic households, the government, or the rest of the world ($u \in HH, GG, RoW$). Accordingly, all assets of the financial and non-financial corporate sectors can be allocated to these three ultimate counterparties.

Unveiling example. The underlying unveiling approach has been described in detail in Diebold and Richter (2021) and Mian et al. (2020). Thus, we only provide an instructive example to explain the approach in our setting. While the general unveiling approach applies to each individual financial instrument listed in the financial accounts data (deposits, bonds, loans, shares, insurance and pension products, gold and SDRs, derivatives and options, other accounts), our example focuses exclusively on bonds. Further, for simplicity, let us not distinguish between financial and non-financial corporations and suppose there is only a single intermediate sector. When we want to allocate the government's bond liabilities to its financing sectors, the first step is to assign the bonds to direct counterparties. Let us assume there are bonds worth 100 dollars in the government's balance sheet *liabilities*. The balance sheets of the remaining sectors indicate that of all bond *assets* in the entire economy (excluding the government itself), 60%, 30%, and 10% are held by the intermediate sector, the rest of the world (foreign sector), and domestic households, respectively. The first step of the unveiling proportionally allocates the government's bond liabilities to the asset holdings of the other sectors according to these shares.

Table 1: *Government debt, unveiling stages*

	Total	*Households*	*Foreign Sector*	*Government*	*Financial Sector*	*Corporates*
Panel A: Bonds						
First Stage (Direkt)	48.92	4.17	13.24	0.00	30.19	1.32
Second Stage (Direkt+Indirekt)	48.92	20.11	24.13	4.45	0.00	0.00
Panel B: Loans						
First Stage (Direkt)	14.10	0.10	2.73	0.00	9.91	1.27
Second Stage (Direkt+Indirekt)	14.10	5.42	7.18	1.78	0.00	0.00

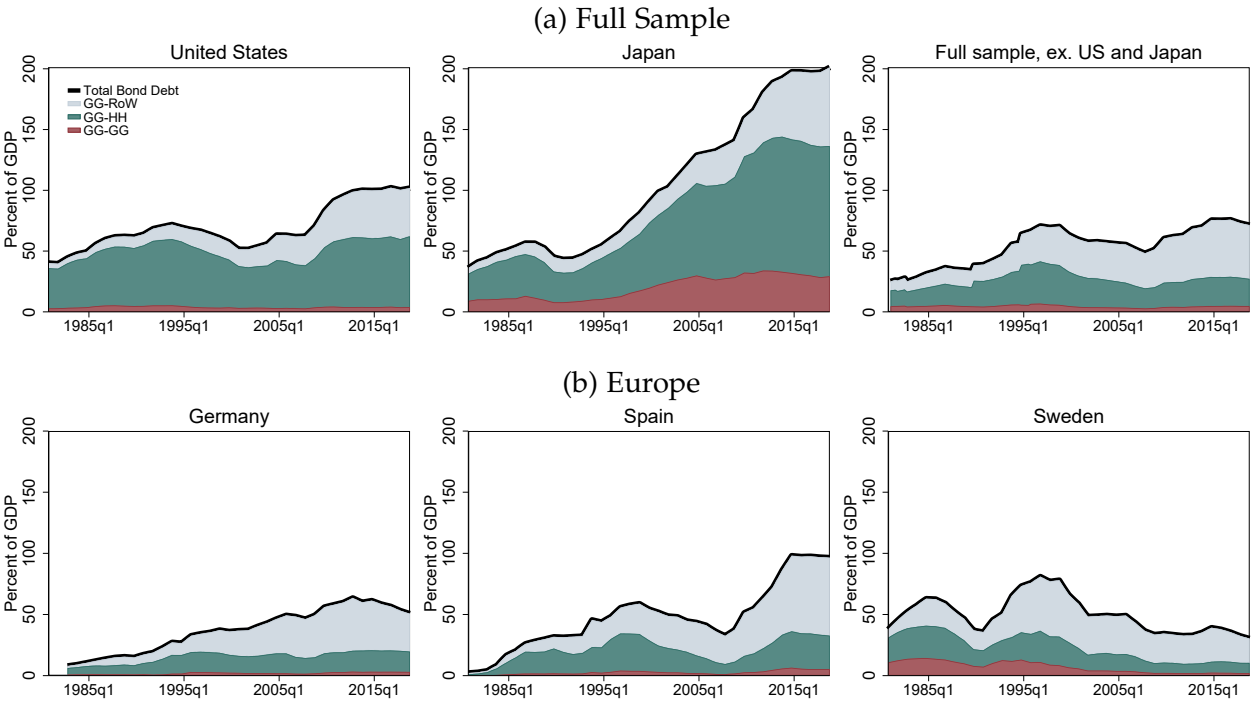
Notes: This table shows the average allocation of government liabilities for the two separate stages of the proportional unveiling approach described in subsection 2.4. Panel A displays the allocation for bonds, and Panel B presents the allocation for loans. In both panels, the first row allocates the entirety of government liabilities (shown for reference in the first column) to households, the foreign sector, the financial sector, and the non-financial corporate sector, thus excluding the government itself. The second row reallocates the direct holdings of the corporate sectors (financial and non-financial) to the three ultimate counterparties: households, the foreign sector, and the government. The figures for the ultimate counterparties in the second row of both panels, thus, represent the total amount of government debt ultimately financed by these sectors, combining both direct and indirect holdings of government debt.

In the second unveiling step, we want to "unveil" the role of the intermediate sector, which is owned by the ultimate counterparties (households, government, rest of the world). Let us assume that the intermediate sector is financing itself exclusively with deposits, while households hold 50% of all deposits in the economy, the foreign sector holds 40%, and the government holds 10%. Again, we can obtain this data from the balance sheets of the ultimate counterparties. Thus, we assign the intermediate sector's deposit liabilities to the ultimate counterparties according to their respective shares in total deposit holdings. Households would now be assumed to hold 40% of the government's bonds, 10% directly, and 30% indirectly via owning 50% of the intermediate sector's liabilities, which in turn holds 60% of the government's bonds. Similarly, the foreign sector would be assumed to hold 54% of the government's bond liabilities, 30% directly, and 24% via holding 40% of the financial sector's 60% bond share. The government, not financing itself directly, would be assumed to have financed itself indirectly with 6% via its share in the financial sector.[10]

Unveiled government debt over time. Table 1 shows the cross-country average results for both unveiling stages for government bonds and loans in panels A and B, respectively. On average, governments have outstanding bond debt of 48.92% of GDP. According to the first stage of the unveiling, 4.17% is held by households, 13.24% by the rest of the world, 30.19% by the financial corporations, and 1.32% by non-financial corporations. In the second stage of the unveiling, the direct holdings of financial and non-financial corporations are re-allocated to the three ultimate counterparties. In turn, the counterparties' holdings consist of the sum of their direct and indirect

[10] An example of the government financing itself might be via (partially) government-owned banks or other corporations that are government-owned.

Figure 4: *Unveiled Government Bonds by country*

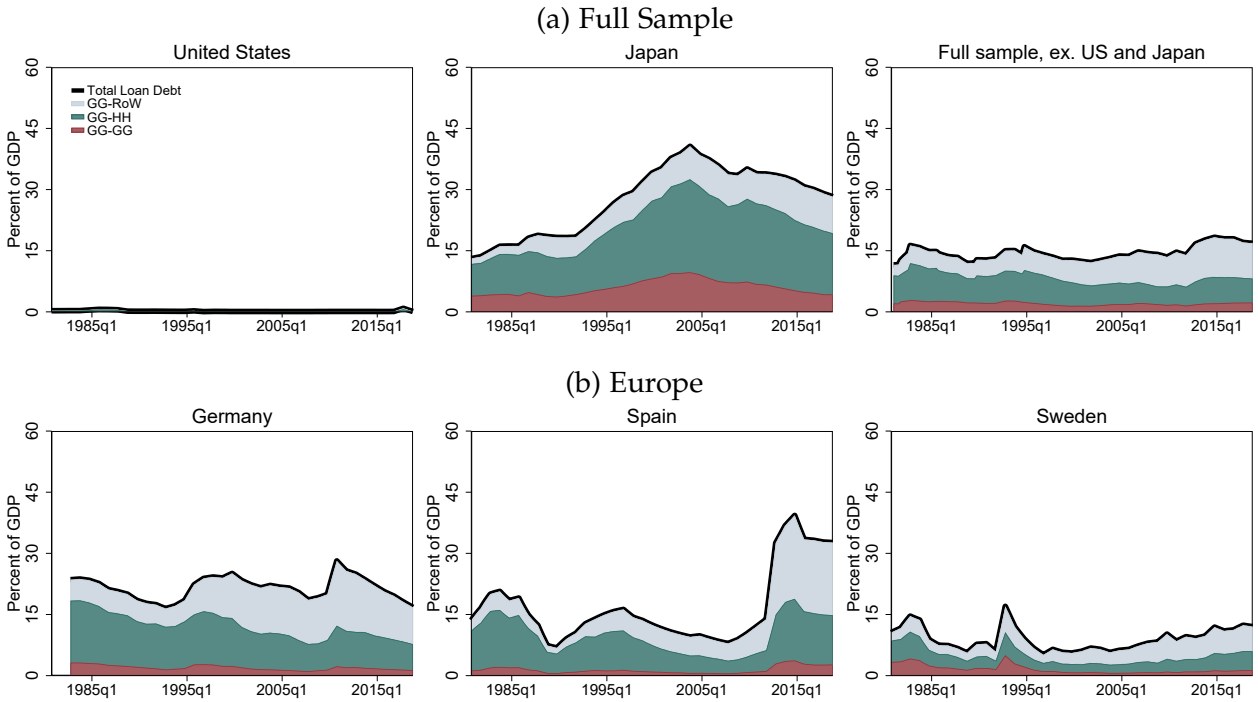


Notes: This figure shows the stock of government bond debt relative to GDP, broken down by ultimate financing counterparty, between 1980 and 2018 for selected countries. Panel (a) displays series for the United States, Japan, and a sample average excluding the United States and Japan. Panel (b) presents series for Germany, Spain, and Sweden. Across panels, government bond liabilities ultimately financed by the government are shown in red (bottom area), bonds ultimately financed by the household sector in green (middle area), and bonds ultimately financed by the foreign sector in gray (top area). The solid black line indicates the total amount of government bond liabilities relative to GDP.

holdings. This shows that, out of all bonds, 20.11% are held by households, 24.13% by the rest of the world, while the government (indirectly) holds 4.45% of its own debt. Panel B contains the corresponding information for the 14.1% of outstanding loans, relative to GDP. As expected, most of these loans are directly held by financial corporations, making the assignment to ultimate counterparties in the second stage unveiling particularly relevant for loans. This unveiling step suggests that 5.42% of the loans are ultimately financed by the domestic household sector while 7.18% are ultimately financed from abroad. Overall, we find that bond financing is more important, considering total liabilities but also considering each ultimate counterparty individually. However, loans still make up a significant fraction of government debt, both on the governments' liability side and on the asset sides of the other sectors.

The above results focus on sample averages. To also understand within-country variation, we show the evolution of bonds and loans over time for the same selected set of countries as in Figure 2, in Figure 4 and Figure 5, respectively. All panels show liabilities held by the rest of the world in gray (top area), by domestic households in green (middle area), and by the government itself in red

Figure 5: *Unveiled Government Loans by country*



Notes: This figure shows the stock of government loan debt relative to GDP, broken down by ultimate financing counterparty, between 1980 and 2018 for selected countries. Panel (a) displays series for the United States, Japan, and a sample average excluding the United States and Japan. Panel (b) presents series for Germany, Spain, and Sweden. Across panels, government loan liabilities ultimately financed by the government are shown in red (bottom area), loan ultimately financed by the household sector in green (middle area), and loan ultimately financed by the foreign sector in gray (top area). The solid black line indicates the total amount of government loan liabilities relative to GDP.

(bottom area). Total government debt in the respective instrument category is indicated by the solid black line.

Focusing on bonds in Figure 4, a clear trend toward increasing international funding is apparent, particularly among the group of European countries shown in the second row. By the end of our sample in 2018, government bonds ultimately financed from abroad make up the largest fraction of total government debt in all three European countries displayed. In contrast, the United States and Japan stand out due to their high levels of bond funding ultimately provided by domestic households, which, by the end of the sample period, constitute the largest share of their government bond liabilities. With the exception of Japan, none of these countries exhibit a substantial portion of government bond debt being indirectly financed by the government itself.

Figure 5 shows the unveiled time series for government loans. As expected, the level of loan liabilities relative to GDP is generally lower than for bonds. In particular, the United States effectively has no loan liabilities over the entire sample. In Japan, loans begin increasing in the early 1990s and continue to rise until the Great Financial Crisis, after which the trend reverses.

This increase is primarily financed by domestic households. Considering the full sample excluding Japan and the United States, we find that the ratio of loans to GDP is remarkably stable over time and roughly equally financed by the domestic household and foreign sectors (rest of the world). In Germany, loans remain fairly stable, fluctuating around 20% of GDP, with a slight shift toward foreign holdings over time. In contrast, Spain and Sweden experience sharp increases following the Euro Crisis and the Scandinavian Financial Crisis in the 1990s, respectively. In Spain, this rise is financed by domestic households and the rest of the world. A similar pattern emerges in Sweden in the 1990s.

Notably, these increases in loan holdings (and government loan liabilities, respectively) occur much more rapidly than the simultaneous increases in bond debt visible in Figure 4. This suggests that loan financing may be particularly relevant during crisis episodes. Across all panels, the trend toward more international funding is much more pronounced for bonds than for loans, consistent with the greater internationalization of bond markets. Overall, we find meaningful time variation in loan holdings across ultimate counterparties.

Taken together, our descriptive findings point towards some degree of substitutability between bonds and loans. This might be particularly relevant when funds are needed at short notice and cannot be raised through traditional bond markets quickly enough, e.g., due to low and decreasing creditworthiness and an accompanying surge in bond yields. The following section proposes a simple model of government finances to rationalize this behavior, linking the costs of credit to the government's choice between bonds and loans.

3. A model of government finances

We provide a simple conceptual framework that formalizes the link between credit ratings, capturing a country's creditworthiness, and the financing choices of sovereigns that may issue debt with bonds and loans. Interest rates on bonds increase as a sovereign's credit rating deteriorates due to a reduced liquidity premium of holding these assets. Because of this (convex) relation, the government substitutes away from bonds and toward loans in response to a rating downgrade. Moreover, the model delivers the testable prediction that a decrease in the credit rating has a larger impact than an equally sized increase, with this difference being more pronounced for a sovereign with low initial rating. Intuitively, this formalizes the idea that highly rated countries experience only small changes in bond yields due to a rating change, whereas low-rated countries are hit by investors flight-to-safety as ratings deteriorates (e.g. Baele et al., 2020; Kekre and Lenel, 2024).

3.1. Model setup

We consider a simple debt portfolio choice problem of a single sovereign. The model is deliberately kept stylized to focus on the link between loans, bonds, and sovereign credit ratings.

Supply of funds. We assume that international capital markets provide the supply of funds in loans ℓ and bonds b, as captured by the following inverse supply functions

$$r^{\ell} = r(\ell) \tag{1}$$

$$r^{b} = r(b) - \mathcal{L}\, c(\omega), \tag{2}$$

where r^{ℓ} and r^{b} denote the respective interest rates. The function $r(\cdot)$ is convex and increasing in its argument, i.e., $r' > 0$ and $r'' \geq 0$. Finally, $\mathcal{L}\, c(\omega) \geq 0$ captures that financing via bonds tends to be cheaper. The parameter $\mathcal{L} \in (0, \bar{\mathcal{L}})$ captures a premium for bonds, reflecting factors such as liquidity, convenience value, or other benefits that investors enjoy when holding bonds instead of loans. The parameter $\bar{\mathcal{L}}$ is such that, in equilibrium, the government is always satisfying $\ell > 0$ and $b > 0$ to focus on an interior equilibrium. The function $c : \omega \mapsto (0, 1]$ maps the (credit)ωorthiness of the government into the fraction of the (liquidity) premium that the government enjoys. We may think of $\omega > 0$ as being a credit rating. We assume $c' > 0$ and $c'' \leq 0$ so that increases in the rating lower interest rates on bonds, and this effect diminishes as ω increases. The idea is that small changes in the credit rating of highly rated countries have a small effect on the liquidity premium, whereas poorly rated countries may be more sensitive to rating changes.

Government portfolio choice. The government chooses the optimal composition of loans and bonds given the level of funds needed, which is given by $d > 0$. Formally, the government solves

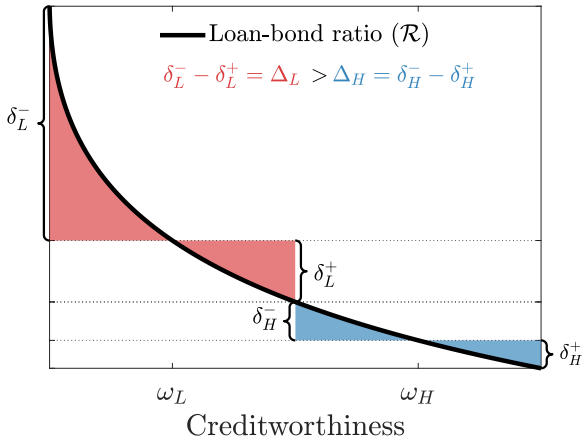
$$\min_{\ell, b, r^{\ell}, r^{b}} r^{\ell}\ell + r^{b}b \quad \text{s.t.} \quad d = \ell + b,$$

and subject to equations (1) and (2), assuming that the government internalizes the supply schedules, given that sovereigns have market power in the provision of government debt.

3.2. Model predictions

To obtain an explicit closed-form solution, we assume that interest rates on loans and bonds are linear in the amount borrowed with each respective instrument, i.e., $r(x) = x/2$ for $x = b, \ell$.

Figure 6: *The loan-bond ratio and creditworthiness*



Notes: The figure shows that the loan-bond ratio $\mathcal{R}$ is a convex function of creditworthiness ω, which implies that (i) downgrades loom larger than upgrades ($\delta_i^- > \delta_i^+$, $i = L, H$) and that (ii) this effect is stronger when the initial creditworthiness is low ($\Delta_L > \Delta_H$).

Solving the model for the optimal choices of loans and bonds allows us to study the loan-bond ratio, $\mathcal{R} = \ell/b$, which conveniently summarizes the government's portfolio choice. The following proposition characterizes the loan-bond ratio as a function of the government's creditworthiness.

Proposition 1. *The loan-bond ratio, $\mathcal{R}$, is a strictly decreasing and convex function of creditworthiness ω.*

The proof is in Appendix A2. When interpreting credit ratings as a measure of creditworthiness, this proposition suggests three predictions that can be tested empirically. First, rating downgrades lead to a reallocation from bonds to loans, i.e., an increase in the loan-bond ratio. Second, the reallocation toward loans after downgrades is larger than the reallocation toward bonds after a similar-sized credit rating upgrade. Third, changes in the credit rating, and downgrades in particular, have larger effects when the initial credit rating is already lower. We illustrate these predictions in Figure 6. It becomes apparent that (i) downgrades have a larger impact than upgrades ($\delta_i^- > \delta_i^+$, $i = L, H$), and that (ii) this effect is stronger when the initial creditworthiness is low ($\Delta_L > \Delta_H$). In the next section, we test these model predictions.

4. Credit Ratings and the governments' funding structures

In this section, we empirically assess the model's prediction that credit rating downgrades lead to substitution away from bonds toward loans, especially for countries with lower rating levels. To this end, we link changes in credit ratings to government bond yields and the issuance of new public debt. We find that these variables are particularly sensitive to rating downgrades for countries

with sovereign credit rating below average, consistent with the theoretical prediction of our model. Specifically, we find that bond yields increase and sovereigns substitute toward loans, while the overall government debt level tends to be unresponsive. In a second step, we show that the decline in bond issuance is associated with reduced bond purchases by both domestic financial institutions and foreign investors. At the same time, the domestic financial sector increases its government loan holdings. Drawing on the unveiled data introduced in section 2, we further document that government loans are increasingly financed by foreign capital. Finally, we show that the reallocation toward loans on the asset side of creditors is associated with a subsequent increase in financial distress, raising financial stability concerns.

4.1. Credit rating changes and loan-bond substitution

Variable definitions. Our model suggests that the effects of rating changes depend on the sign of the rating change and on the initial credit rating. To test this idea, we consider an indicator variable specification that distinguishes between credit rating upgrades and downgrades and countries rated below and above average. Formally, we define indicators for rating decreases (DR_{it}) and increases (IR_{it}) as

$$DR_{i,t} = \begin{cases} 1, & \text{if } \Delta_1 \text{Rating}_{i,t} < 0 \\ 0, & \text{Otherwise,} \end{cases} \qquad \text{and} \qquad IR_{i,t} = \begin{cases} 1, & \text{if } \Delta_1 \text{Rating}_{i,t} > 0 \\ 0, & \text{Otherwise.} \end{cases} \tag{3}$$

Note that $\Delta_h x_{i,t} = x_{i,t} - x_{i,t-h}$ denotes the h-period change of any variable $x_{i,t}$. Thus, the indicators above depend on the first difference of the rating index at a quarterly frequency. To capture country-time observations with a low credit rating, we define an additional indicator variable for below average rated countries

$$BAR_{i,t} = \begin{cases} 1, & \text{if Rating}_{i,t} < \overline{Rating} \\ 0, & \text{Otherwise,} \end{cases} \tag{4}$$

where $\overline{Rating}$ denotes the arithmetic average of the rating index over the full sample. According to the model, this variable should account for differences in a country's sensitivity to rating changes along different rating levels, where countries with higher ratings are assumed to be less sensitive to

fluctuations in their rating. Interestingly, this average sovereign rating is approximately 26.5 points, which coincides perfectly with the distinction between "high medium" and "upper medium" rated sovereigns (or, e.g., the move from AA- to A+ for S&P).

Econometric specification. Interacting the indicators from Equation 3 and Equation 4 allows us to capture all four cases that the model suggests, i.e., we can discriminate between rating increases and decreases conditional on whether or not a country is also rated below the average. Formally, we can estimate the following predictive regression

$$\begin{aligned} y_{i,t+h} = \alpha_i + \alpha_t + \beta_1 DR_{i,t} + \beta_2 IR_{i,t} + \beta_3 BAR_{i,t} + \\ + \gamma_1 DR_{i,t} \times BAR_{i,t} + \gamma_2 IR_{i,t} \times BAR_{i,t} + \Gamma X_{i,t-1} + \nu_{i,t+h}, \end{aligned} \tag{5}$$

with $\nu_{i,t+h}$ being an error term, while $y_{i,t+h}$ it the outcome of interest. When the outcome is a stock variable or a yield, we use a long difference as outcome, i.e., $\Delta_{h+1} x_{i,t+h} = x_{i,t+h} - x_{i,t-1}$. When the outcome is the issuance of new debt via loans or bonds, we use the sum of all issuance over the response horizon, i.e., $\sum_{j=0}^{h} x_{i,t+j}$.[11,12] The right-hand side amounts to a two-way fixed effects specification with country and time fixed effects, the above defined indicators and their interactions, and a vector of lagged controls, $X_{i,t-1}$. The control vector includes a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI.

Government bond yields and debt issuance. We present the results for the ten-year bond yield, as well as newly issued bonds and loans in Table 2, along with standard errors in parentheses that are clustered by country and time. The results for the change in the ten-year bond yield between $t-1$ and $t+4$ are displayed in columns (1) to (3). Column (1) begins by jointly estimating the coefficients for all indicators (and their interactions) from Equation 5. The results show that rating decreases for below-average rated countries are followed by an increase in government bond yields of about 1.33 percentage points, with the estimate being statistically significant at the 5% level. Conversely, downgrades without conditioning on a below-average rating display a statistically

[11] Data from the OECD financial accounts, which record figures in nominal terms, are always expressed relative to nominal GDP to ensure stationarity.

[12] Note that we include the change from $t-1$ onward to capture current period effects. The appendix reports robustness specifications for the same window-length beginning in $t=0$ to address potential reverse causality concerns.

Table 2: *Government bond yields and newly issued debt in response to rating changes*

	Δ_5 Bond yield$_{i,t+4}$			$\Sigma_{j=0}^{4}$ Bond Issuance$_{i,t+j}$			$\Sigma_{j=0}^{4}$ Loan Issuance$_{i,t+j}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$DR_{i,t} \times BAR_{i,t}$	1.333**	1.410**		-3.604***	-3.663***		3.251**	3.442**	
	(0.640)	(0.671)		(1.146)	(1.188)		(1.224)	(1.257)	
$DR_{i,t}$	0.393**	0.390**		1.970***	1.995***		0.639	0.628	
	(0.181)	(0.181)		(0.531)	(0.534)		(0.534)	(0.533)	
$IR_{i,t} \times BAR_{i,t}$	-0.249		-0.568**	0.440		0.931	-0.646*		-1.385**
	(0.152)		(0.270)	(0.487)		(0.571)	(0.375)		(0.598)
$IR_{i,t}$	0.009		0.054	-0.385		-0.583	0.063		0.180
	(0.080)		(0.083)	(0.407)		(0.399)	(0.195)		(0.226)
$BAR_{i,t}$	-0.385	-0.436	0.189	3.418*	3.511*	2.516	-1.105	-1.238	0.225
	(0.472)	(0.483)	(0.411)	(1.946)	(1.933)	(1.892)	(1.047)	(1.055)	(1.237)
R^2	0.550	0.549	0.516	0.462	0.462	0.450	0.482	0.481	0.455
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2840	2840	2840	2840	2840	2840	2840	2840	2840

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables are the change in the ten-year government bond yield between $t-1$ and $t+4$ in columns (1) to (3), the cumulative issuance of new government bonds relative to GDP from t to $t+4$ in columns (4) to (6), and the cumulative new issuance of government loan liabilities relative to GDP over the same period in columns (7) to (9). $DR_{i,t}$, $IR_{i,t}$, and $BAR_{i,t}$ refer to indicator variables for government credit rating decreases, increases, and a below-average rating level, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

significant increase in yields of only 0.39 percentage points. This finding is consistent with our theoretical model, in which the yield sensitivity to downgrades decreases in the credit rating.[13]

All remaining coefficients in column (1) are not statistically different from zero. In terms of the point estimate, however, we find that rating increases reduce the bond yield by more for low-rated countries. This qualitative difference is consistent with our theoretical model because it predicts a greater sensitivity when credit ratings are low, regardless of the direction in which the credit rating changes. Our main findings are confirmed in columns (2) and (3), where we estimate separate specifications for rating increases and decreases. Notably, rating increases at below-average rating levels become significant in column (3), when downgrades are excluded from the estimation. However, the estimate remains far smaller in magnitude compared with the coefficient associated with $DR_{i,t} \times BAR_{i,t}$ in columns (1) and (2).

How does this increase in funding costs relate to the issuance of new government debt? According to the theoretical model, a decrease in creditworthiness reduces the liquidity premium for bonds, prompting a reallocation from bonds toward loans. This effect is magnified for countries with a low credit rating. To test this model prediction, columns (4) to (9) study government bond

[13] In the model, this is an immediate consequence from the liquidity premium of bonds being a concave and increasing function of credit ratings (or creditworthiness).

and loan issuance in the wake of rating changes. Starting with column (4), we find that rating downgrades for countries rated below average are followed by a sizable decline in the issuance of new bonds, with the effect being statistically significant at the 1% level. This confirms an active shift away from bond financing. Importantly, since we study new bond issuance, our results are not driven by asset revaluation effects due to higher bond yields. Quantitatively, we find that new issuance of bonds declines by 3.6% of GDP. In contrast, a downgrade without conditioning on a below-average rating ($DR_{i,t}$) is associated with increased bond issuance. This likely reflects the forward-looking nature of credit ratings, where anticipated increases in government borrowing may lead to a lower rating today. If anything, this reverse causality should bias the coefficient on $DR_{i,t} \times BAR_{i,t}$ toward zero, meaning our estimate likely represents a conservative lower bound.[14]

In contrast to rating downgrades, we find no significant effects of rating increases. Rating upgrades are associated with declining bond issuance, as, contrary to downgrades, rating increases may reflect lower anticipated future borrowing. For countries with initially low ratings, upgrades may sufficiently reduce borrowing costs to make bond issuance feasible again, resulting in increased bond issuance. When estimating this specification separately for rating increases and decreases in columns (5) and (6), we obtain similar results.

Columns (7) to (9) run an identical set of specifications for newly issued government loans. We find that loan issuance increases significantly following rating downgrades for below-average rated countries. Strikingly, the magnitude of this increase is 3.25% of GDP and almost perfectly offsets the observed decrease in bond issuance shown in columns (4) and (5). This suggests that substitution from bonds to loans is nearly perfect, with no meaningful change in the overall level of debt. Such a scenario aligns well with the theoretical model in which overall debt is kept constant. Rating downgrades without conditioning on a below-average credit rating show a similar sign but the effect is substantially smaller in magnitude and not statistically significant. Rating upgrades at low levels yields a statistically significant coefficient with the opposite sign but substantially smaller compared with the estimate associated with $DR_{i,t} \times BAR_{i,t}$, confirming the non-linearity from the theoretical model. Together with the results for bond issuance, this also indicates a substitution away from loans and toward bonds when the ratings of below-average-rated countries improve. Columns (8) and (9) confirm these findings for specifications that estimate the effects of rating increases and decreases separately.

Overall, our results on bond and loan issuance confirm substitution away from bonds and toward

[14]While only significant at the 10% level, the coefficient for below-average-rated countries is likely subject to the same reverse causality issue. Thus, we focus on the estimated coefficient for $DR_{i,t} \times BAR_{i,t}$.

loans when the rating of below-average rated countries further deteriorates, broadly confirming the theoretical prediction of our model.

Stock of government debt. Next, we study the existing stock of government debt as well as its composition. We do so because new issuance makes up only a fraction of total debt and, by definition, does not account for revaluations, repayments, and maturing securities. Concretely, we estimate Equation 5 and use the change in the ratio of the stock of loans to the stock of bonds, the loan-bond ratio, between $t-1$ and $t+4$ as our outcome variable. Likewise, we consider the same (long) difference for the stock of total government debt relative to GDP. The vector of controls and the computation of standard errors remains unchanged. The results are displayed in Table 3.[15]

Columns (1) to (3) show the results for the loan-bond ratio. Consistent with our previous results we find that rating decreases for countries rated below average are followed by a strong increase in the loan-bond ratio that is statistically significant at the one percent level. In the full specification in column (1), it amounts to an increase by 0.15. To understand the magnitude, consider a simple example. Suppose the initial level of loans and bonds is 100 billion each so that the corresponding loan-bond ratio equals unity. Then, the increase of the loan-bond ratio by 0.15 could come about, for example, via an increase in loans by 7 billion and an equally sized decrease of bonds.[16] All other estimates in columns (1) to (3) are comparatively small and tend to be insignificant, at least at the 5% level.

In columns (4) to (6) of Table 3, we present the estimates for total government liabilities relative to GDP. We find that total debt to GDP tends to be unresponsive to credit downgrades for countries rated below average, consistent with our previous finding of bond decreases and loan increases offsetting each other. While the point estimate is positive, it is also completely insignificant, even at the 68% confidence level. In comparison, downgrades for all countries, not conditioning on the rating being below average, lead to a statistically significant and large increase in debt. This echoes our earlier finding that forward looking rating agencies downgrade countries in response to higher expected future debt. Importantly, however, we find no evidence of this effect being differentially larger for countries that are rated below average. Finally, we note that the zero response of government debt to $DR_{i,t} \times BAR_{i,t}$ is consistent with our interpretation of loans and bonds functioning as substitutes, rather than complements in government financing.

[15] Note that the sample expands slightly, as data on total outstanding debt is more widely available than flow data. Restricting observations to a constant sample where flows are also available does not alter the results.

[16] To see this, consider $(100+x)/(100-x)-1=0.15$ and solve for x, which is approximately 7.

Table 3: *Changes in government liability composition and total outstanding debt in response to rating changes*

	Δ_5 Loan-bond ratio$_{i,t+4}$			Δ_5 Total gov. debt$_{i,t+4}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$DR_{i,t} \times BAR_{i,t}$	0.150***	0.168***		0.818	0.969	
	(0.050)	(0.053)		(1.380)	(1.533)	
$DR_{i,t}$	-0.006	-0.008		2.413***	2.465***	
	(0.021)	(0.021)		(0.865)	(0.866)	
$IR_{i,t} \times BAR_{i,t}$	-0.063		-0.092*	0.212		-0.215
	(0.049)		(0.053)	(0.921)		(1.116)
$IR_{i,t}$	0.009		0.014	-1.007*		-1.072**
	(0.018)		(0.019)	(0.497)		(0.501)
$BAR_{i,t}$	-0.106*	-0.119*	-0.055	-0.336	-0.292	0.444
	(0.062)	(0.060)	(0.070)	(1.674)	(1.665)	(1.918)
R^2	0.174	0.172	0.168	0.545	0.543	0.535
Country fixed effects	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓
Observations	3049	3049	3049	3049	3049	3049

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables are the change in the loan-bond ratio in government liabilities between $t-1$ and $t+4$ in columns (1) to (3), and the change in the amount of total outstanding government debt relative to GDP between $t-1$ and $t+4$ in columns (4) to (6). $DR_{i,t}$, $IR_{i,t}$, and $BAR_{i,t}$ refer to indicator variables for government credit rating decreases, increases, and a below-average rating level, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects.. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

Robustness. A concern may be that the financial accounts data used above refers to the general government, which includes lower levels of sovereigns, like, e.g., municipalities. We generally focus on the general government since data coverage is the largest. We can, however, repeat the estimation with those observations for which the financial accounts contain the above data for the central government. The corresponding results are provided in Table A3.2 and Table A3.3. Overall, the results are very similar to the baseline employing general government data, and equally significant. The only noteworthy difference is that effects on the loan-bond ratio become even larger, increasing from 0.15 in the baseline to 0.22 when focusing on central governments. This suggests that our results are not driven by local governments.

To address potential concerns about the chosen timing in our preferred specification, Table A3.4 shifts the 1-year window on the left-hand side of Equation 5 relative to the timing of our regressors. For bond issuance, loan issuance, and the change in total government debt, the table shows time windows starting at $h \in \{-1, 0, 1, 2\}$, with $h = 0$ corresponding to our baseline specification.[17] Results across all estimations closely correspond to our baseline, confirming that they are a robust finding in the data, rather than a unique feature of the timing in our baseline.

Similarly, Table A3.5 employs alternative definitions of the below-average-rated indicator to

[17]We provide a similar exercise for bond yields and the loan-bond ratio in Figure 7.

address concerns that our results might be driven by a few coinciding indicators. First, we lag the $BAR_{i,t}$ indicator relative to the change in ratings, making it pre-determined and inactive when a country becomes low-rated only due to a recent rating change in t. We report the coefficient for $DR_{i,t} \times BAR_{i,t-1}$ alongside our baseline coefficient for $DR_{i,t} \times BAR_{i,t}$, finding both to yield similar results. Second, the baseline BAR-indicator might be too rigid in excluding countries that have only just regained above-average rating status. In such cases, it may be reasonable to include observations that have been rated below average in the recent past. To account for this, we redefine the BAR-indicator to capture whether a country has been rated below average at any point between t and $t-4$. As ratings are, on average, very stable, however, this does not lead to diverging results.

4.2. Counterparties of loan-bond substitution

The above results suggest that sovereigns substitute away from bond financing toward loan financing in the wake of a credit rating downgrade when their overall credit rating is sufficiently low. This implies that other creditors must reallocate their assets away from government bonds and toward loans. This shift may be significant, as the government bonds of the developed economies studied in this paper are marketable and highly liquid assets, while loans may be less so, raising financial stability concerns (Adrian and Shin, 2010).

First stage unveiling. We study which creditors finance the increase in loans and reduce the credit provided via bonds, and to which extent. First, we focus on the direct holdings building on the unveiled data introduced in subsection 2.4. The vast majority of government liabilities (true for both bonds and loans) is held directly either by the financial intermediaries or the foreign sector (see Table 1). In contrast, households typically do not hold government debt directly and lending from the non-financial corporate sector to governments is negligible. Therefore, we run the regression specified in Equation 5, but use direct holdings of bonds and loans, either by the financial sector or the foreign sector, as outcome variables. These outcomes are based on stock variables from the financial accounts, and the outcome is defined as the change in stocks between $t+4$ and $t-1$. The regression specification remains unchanged, including control variables and standard error construction.

The results are presented in columns (1) to (4) in Table 4. Focusing on our regressor of interest, $DR_{i,t} \times BAR_{i,t}$, we find that both the financial sector and the foreign sector hold less bonds and more loans. For the financial sector, the increase in loan holdings is somewhat larger and statistically

Table 4: *Reallocation of government liabilities, decomposition by direct and ultimate financing counterparty*

	Direct financing (first stage unveiling)				*Ultimate financing (second stage unveiling)*			
	Δ_5*Financial Sector*$_{i,t+4}$		Δ_5*Foreign Sector*$_{i,t+4}$		Δ_5*Household Sector*$_{i,t+4}$		Δ_5*Foreign Sector*$_{i,t+4}$	
	Bonds (1)	*Loans* (2)	*Bonds* (3)	*Loans* (4)	*Bonds* (5)	*Loans* (6)	*Bonds* (7)	*Loans* (8)
$DR_{i,t} \times BAR_{i,t}$	-1.490*	2.514**	-1.709	1.079**	-0.993**	0.847***	-2.516*	2.551**
	(0.807)	(0.942)	(1.229)	(0.411)	(0.452)	(0.303)	(1.433)	(0.980)
$DR_{i,t}$	0.878	0.201	0.197	-0.050	0.634**	0.028	0.558	0.234
	(0.532)	(0.328)	(0.365)	(0.229)	(0.291)	(0.147)	(0.487)	(0.468)
$IR_{i,t} \times BAR_{i,t}$	0.480	-0.260	0.318	-0.089	0.877**	-0.002	0.285	-0.399
	(0.468)	(0.321)	(0.551)	(0.283)	(0.385)	(0.143)	(0.544)	(0.407)
$IR_{i,t}$	-0.561	-0.065	-0.300	-0.155	-0.506*	-0.050	-0.219	-0.058
	(0.423)	(0.150)	(0.285)	(0.130)	(0.251)	(0.077)	(0.373)	(0.118)
$BAR_{i,t}$	0.838	-0.561	1.953*	-2.416**	-0.578	-0.474	3.141**	-2.185**
	(1.747)	(0.370)	(0.965)	(0.990)	(1.194)	(0.310)	(1.450)	(0.951)
R^2	0.455	0.392	0.233	0.539	0.462	0.428	0.301	0.469
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2859	2859	2859	2859	2859	2859	2859	2859

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables in columns (1) and (2) are the changes in government bonds and loans, relative to GDP, between $t-1$ and $t+4$, that are directly held by the financial sector, as identified using the unveiling approach described in subsection 2.4. In columns (3) and (4), the dependent variables are identically defined changes in government bonds and loans that are directly held by the foreign sector. Columns (5) to (8) show changes in bonds and loans that are *ultimately* held by the household and foreign sectors, according to our unveiling procedure, combining direct and indirect holdings of government debt. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

significant at the 5% level. In contrast, the decrease in bond holdings is slightly smaller and less significant. For the foreign sector, the decrease in bond holdings is more pronounced, although imprecisely estimated. In turn, the increase in loans is smaller, but statistically significant at the 5% level. Note that the combined reduction in bond holdings (or combined increase in loans) by the financial and foreign sector closely resembles the estimates for new issuance we found in Table 2. Interestingly, the domestic financial sector increases its holdings of government loans by 2.51 percent of GDP, more than twice as large as the estimated increase for the foreign sector, suggesting a relatively stronger re-balancing towards loans for the financial sector. As loans are typically less liquid assets, this increase in risk taking by banks (consider that these are loans to governments that have just been downgraded) potentially increases financial fragility.

Second stage unveiling. The corporate sector, including financial intermediaries, is ultimately owned by domestic households, the government, or the foreign sector. Consequently, the reallocation in the balance sheet of financial intermediaries is ultimately borne by the sectors that ultimately provide the funding. To investigate this reallocation from the perspective of ultimate counterparties

financing government debt, we leverage the "second stage" unveiled data that allocates all corporate holdings to the ultimate financiers via a proportionality assumption, as explained in subsection 2.4. As visible in Table 1, domestic households and the foreign sector are typically the largest ultimate financiers for government debt, when combining direct and indirect holdings. Hence, we focus on these two sectors and, again, consider changes in the stock of government liabilities owned by these two sectors analogously to the other stock variables studied before, while also keeping the specification unchanged.

The results are shown in columns (5) to (8) of Table 4. As before, focusing on our regressor of interest, $DR_{i,t} \times BAR_{i,t}$, we find that government bonds ultimately held by domestic households decrease by around 1% of GDP, with the effect being statistically significant at the 5% level. Loans ultimately financed by the household sector increase by a slightly smaller amount, with the coefficient significant at the 1% level. This suggests that the overall financing of the government by domestic households remains virtually unchanged, mirroring the loan–bond substitution on sovereigns' balance sheets. Strikingly, the coefficients for the foreign sector, presented in columns (7) and (8), are more than 2.5 times larger, while being nearly identical in absolute size. Similar to the household sector, the foreign sector therefore does not change its overall funding of the government but reallocates it from bonds to loans. Interestingly, in doing so, it also reallocates towards more indirect funding, as the overall change for direct funding in columns (3) and (4) is negative, while the total change when considering direct and indirect funding is virtually zero.[18]

Overall, our findings suggest that both domestic households and the foreign sector substitute toward loans on the asset side of their balance sheets, with the foreign sector also reallocating toward more indirect funding. This may have important economic implications if these changes increase the vulnerability of the domestic financial system. Brunnermeier and Pedersen (2009) emphasize the role of liquidity differences between different assets in shaping bank risk, noting that loans, in particular, tend to be difficult to liquidate during periods of financial turmoil. The transmission of financial balance sheet risks to real economic outcomes has been documented by Chodorow-Reich (2014), while Diebold and Richter (2021) find that it is especially the volatile foreign funding of illiquid domestic loans that puts the economy at risk.

[18]The foreign sector's indirect funding changes of the government would be: $-2.516 - (-1.709) = -0.807$ for Bonds, and $2.551 - 1.079 = 1.472$ for loans.

4.3. Implications for financial stability

Econometric specification. In this section, we link the previous results of loan-bond substitution to increased instability in the financial sector, using the financial distress index from Romer and Romer (2017).[19] To gauge the relationship between changing loan-bond ratios for different sectors and financial fragility, we run the following regression

$$\Delta_h y_{i,t+h} = \alpha_i + \alpha_t + \beta_1 \, \Delta_4 \text{Loan-bond ratio}_{i,t} + \Gamma \, Z_{i,t} + v_{i,t+h}, \tag{6}$$

where $v_{i,t+h}$ is an error term, and the outcome variable $\Delta_h y_{i,t+h}$ refers to changes in the financial distress index between t and $t+h$, while $\Delta_4 \text{Loan-bond ratio}_{i,t}$ refers to the one-year change in the loan-bond ratio of asset holdings for different sectors. It is defined as the change between $t-4$ and t. We additionally include two-way fixed effects for country and time, as well as the control vector $Z_{i,t}$. This vector contains four lags of GDP growth, the rating index, the natural logarithm of the price level based on the CPI, and the distress index to cover the entire period over which the change in the loan-bond ratio is measured. We also control for the level of the loan-bond ratio and the total level of assets at the sector level in $t-5$, i.e., the period before the change in the loan-bond ratio begins, as well as the change in total assets for the respective sector between $t-4$ and t. The idea is to hold the overall balance sheet size constant to focus only on compositional changes.[20]

Direct counterparties and financial distress. Panel A in Table 5 presents the coefficients for the loan-bond ratio in government liabilities over $h \in \{1, \ldots, 10\}$ quarters. Consistent with our previously stated expectation that a shift toward a less liquid instruments may increase financial fragility, we find that financial distress rises following an increase in the government's loan-bond ratio. Notably, financial distress continues to rise throughout the entire period considered, with coefficients becoming progressively more statistically significant over time. However, this increase in financial fragility is likely driven by the sectors that hold government liabilities as assets. For the government itself, being able to access loans when bond market liquidity declines may not necessarily be disadvantageous. Therefore, Panels B and C focus on the two largest direct holders

[19] Their index ranks financial distress on a range between 0 and 12 on a bi-annual basis, which we linearly interpolate to quarterly frequency.

[20] When the sector of interest is the government, this means including the level and change in total government liabilities. When the sector of interest is one of the sectors holding government debt as an asset (e.g., the financial or foreign sector), this means including the level and change in the total assets of that sector.

Table 5: *Loan to bond substitution and financial distress, government liabilities and direct counterparties*

	Δ_h *Financial Distress*$_{i,t+h}$									
	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$	$h=8$	$h=9$	$h=10$
Panel A: Government liabilities										
Δ_4 Loan-bond ratio$_{i,t}$	0.29	0.53*	0.73*	0.90*	1.09*	1.30**	1.50**	1.63***	1.71***	1.72***
	(0.19)	(0.30)	(0.41)	(0.52)	(0.60)	(0.61)	(0.59)	(0.57)	(0.57)	(0.58)
R^2	0.406	0.450	0.507	0.551	0.582	0.603	0.621	0.633	0.640	0.647
Panel B: Direct holdings: financial sector										
Δ_4 Loan-bond ratio, FI$_{i,t}$	0.22	0.39	0.53	0.69	0.88	1.13	1.38*	1.60**	1.78**	1.90***
	(0.22)	(0.36)	(0.52)	(0.68)	(0.81)	(0.81)	(0.75)	(0.68)	(0.64)	(0.65)
R^2	0.408	0.450	0.507	0.551	0.582	0.602	0.619	0.631	0.637	0.643
Panel C: Direct holdings: foreign sector (rest of the world)										
Δ_4 Loan-bond ratio, RoW$_{i,t}$	0.19**	0.38**	0.52**	0.60**	0.69**	0.80**	0.91**	1.01**	1.08**	1.08**
	(0.09)	(0.16)	(0.19)	(0.25)	(0.31)	(0.36)	(0.40)	(0.43)	(0.45)	(0.44)
R^2	0.410	0.455	0.512	0.554	0.583	0.602	0.618	0.629	0.635	0.640
Panel D: Direct holdings: financial sector and foreign sector (rest of the world)										
Δ_4 Loan-bond ratio, FI$_{i,t}$	0.05	0.03	0.04	0.15	0.32	0.52	0.76	0.96	1.15**	1.32**
	(0.22)	(0.36)	(0.55)	(0.74)	(0.88)	(0.86)	(0.75)	(0.61)	(0.51)	(0.51)
Δ_4 Loan-bond ratio, RoW$_{i,t}$	0.18**	0.37**	0.51**	0.56**	0.61*	0.67*	0.71*	0.76**	0.78**	0.74**
	(0.07)	(0.15)	(0.20)	(0.26)	(0.31)	(0.34)	(0.36)	(0.37)	(0.37)	(0.34)
R^2	0.414	0.459	0.515	0.557	0.587	0.606	0.622	0.634	0.641	0.646
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2344	2344	2344	2344	2344	2344	2344	2344	2344	2344

Notes:) This table presents quarterly regression results based on Equation 6, as specified in the text. The dependent variable is the change in the financial distress index, constructed by Romer and Romer (2017), between t and $t+h$. In Panel A, the independent variable is the change in the loan-bond ratio of government liabilities between $t-4$ and t. In Panel B, the independent variable is the change in the loan-bond ratio of government liabilities that are directly held by the financial sector, as identified using the unveiling approach described in subsection 2.4, over the same period. In Panel C, the independent variable is the change in the loan-bond ratio of government liabilities that are directly held by the foreign sector, likewise identified using our unveiling approach, and measured over the same period. Panel D includes the changes in the loan-bond ratio of government liabilities that are directly held by the financial and foreign sectors jointly. Controls include four quarterly lags of GDP growth, the rating index, the natural logarithm of the price level based on the CPI, and the distress index. We also control for the level of the loan-bond ratio and the total level of assets at the sector level in $t-5$, i.e., the period before the change in the loan-bond ratio begins, as well as the change in total assets for the respective sector between $t-4$ and t. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

of government debt: the financial sector and the foreign sector.

The results for the direct holdings of government debt by the financial and foreign sectors reveal that increasing loan-bond ratios on their asset side contribute to higher financial fragility for both sectors. For the financial sector, the pass-through from rising loan-bond ratios to financial distress is more delayed, becoming statistically significant only after $h=6$, i.e., after approximately 18 months. Thereafter, the coefficients continue to increase in both magnitude and significance. In contrast, for direct holdings of government debt by the foreign sector, the pass-through from a shift toward loans appears to be more immediate, with coefficients being statistically significant at the 5% level

across all horizons. However, especially at longer horizons, the coefficient magnitudes are lower than those for the financial sector. For example, at $h = 10$, the coefficient for the financial sector is 1.9, compared to only 1.08 for the foreign sector.

In Panel D, we estimate the coefficients for the financial and foreign sectors jointly.[21] We find that, while both sectors retain positive coefficients, those for the financial sector are reduced more substantially. Coefficients for changes in the loan-bond ratio of the foreign sector remain statistically significant at the 5% or 10% level across all horizons. For the financial sector, coefficients are significant at the 5% level only at horizons 9 and 10. Although imprecisely estimated, they remain larger than those for the foreign sector for $h > 6$. That said, the risk posed by increasing loan-bond ratios for government debt within the financial sector may still depend on its ultimate funding source, something we can investigate using the data obtained from the second stage of the unveiling.

Ultimate counterparties and financial distress. In Table 6, we focus on the two sectors that ultimately finance most government debt: households and the foreign sector. In Panel A, our regressor is the ratio of government loans to government bonds ultimately financed by the household sector.[22] We find that increases in the loan-bond ratio ultimately financed by the household sector are, consistent with previous results, associated with increasing financial distress. All coefficients are statistically significant at the 5% or 10% level. In Panel B, we apply the same estimation approach to the ratio of government loan and bond liabilities ultimately financed by the foreign sector, combining both direct and indirect holdings. Compared to the results for direct holdings reported in the previous table, the coefficients increase by more than half on average, with most becoming statistically significant at the 1% level (except for $h = 1$). This amplification suggests that indirect holdings, i.e., foreign financing of government debt channeled through domestic intermediaries, contribute significantly to rising financial distress. It is also consistent with the previous result of the foreign sector not only shifting from bonds to loans but also increasingly financing government debt indirectly through domestic intermediaries.

Finally, in Panel C, we again estimate the two previous coefficients jointly. Strikingly, coefficients for the household sector become statistically insignificance and virtually zero across all horizons. This may indicate that, without controlling for the loan-bond ratios of other sectors, the household

[21] Note that we cannot include the loan-bond ratio in government liabilities form Panel A here. As the vast majority of government loans and bonds, over 80% on average, are directly held either by the financial sector or the rest of the world, this information is almost completely captured by the two included regressors; see Table 1.

[22] As discussed in the previous section, the vast majority of government liabilities held by households are held indirectly, for example, through household deposits in the financial sector, which itself holds government liabilities. In contrast, the foreign sector's ultimate holdings include a larger share of direct holdings.

Table 6: *Loan to bond substitution and financial distress, ultimate counterparties*

	Δ_h *Financial Distress*$_{i,t+h}$									
	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$	$h=8$	$h=9$	$h=10$
Panel A: Total holdings: households										
Δ_4 Loan-bond ratio, HH $_{i,t}$	0.35*	0.63**	0.85*	1.06*	1.26*	1.45**	1.60**	1.65***	1.64***	1.58**
	(0.19)	(0.30)	(0.47)	(0.54)	(0.61)	(0.60)	(0.58)	(0.57)	(0.58)	(0.58)
R^2	0.394	0.438	0.496	0.541	0.573	0.596	0.614	0.627	0.634	0.640
Panel B: Total holdings: foreign sector (rest of the world)										
Δ_4 Loan-bond ratio, RoW $_{i,t}$	0.36**	0.68***	0.93***	1.10***	1.27***	1.46***	1.63***	1.75***	1.81***	1.79***
	(0.13)	(0.21)	(0.29)	(0.37)	(0.45)	(0.49)	(0.54)	(0.57)	(0.59)	(0.57)
R^2	0.400	0.444	0.502	0.547	0.578	0.600	0.618	0.631	0.639	0.645
Panel C: Total holdings: households and foreign sector (rest of the world)										
Δ_4 Loan-bond ratio, HH $_{i,t}$	-0.07	-0.21	-0.31	-0.21	-0.09	-0.03	-0.03	-0.16	-0.30	-0.29
	(0.30)	(0.64)	(0.94)	(1.10)	(1.16)	(1.04)	(0.86)	(0.73)	(0.69)	(0.69)
Δ_4 Loan-bond ratio, RoW $_{i,t}$	0.40*	0.80	1.11*	1.23	1.33	1.49*	1.68**	1.91**	2.06**	2.01**
	(0.20)	(0.48)	(0.63)	(0.76)	(0.82)	(0.80)	(0.78)	(0.80)	(0.84)	(0.82)
R^2	0.403	0.448	0.507	0.551	0.582	0.603	0.620	0.633	0.639	0.645
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2227	2227	2227	2227	2227	2227	2227	2227	2227	2227

Notes:) This table presents quarterly regression results based on Equation 6, as specified in the text. The dependent variable is the change in the financial distress index, constructed by Romer and Romer (2017), between t and $t+h$. In Panel A, the independent variable is the change in the loan-bond ratio of government liabilities between $t-4$ and t, that are ultimately financed by domestic households (thus combining direct and indirect holdings), as identified using the unveiling approach described in subsection 2.4. In Panel B, the independent variable is the change in the loan-bond ratio of government liabilities that are ultimately financed by the foreign sector, likewise identified using our unveiling approach, and measured over the same period. Panel C includes the changes in the loan-bond ratio of government liabilities that are ultimately financed by households and the foreign sectors jointly. Controls include four quarterly lags of GDP growth, the rating index, the natural logarithm of the price level based on the CPI, and the distress index. We also control for the level of the loan-bond ratio and the total level of assets at the sector level in $t-5$, i.e., the period before the change in the loan-bond ratio begins, as well as the change in total assets for the respective sector between $t-4$ and t. All specifications additionally include country and time fixed effects.Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

coefficients in Panel A simply proxy for the broader shift toward loans on the government's liability side, of which household holdings are a subset. In stark contrast, the coefficients for the foreign sector turn out to be the largest across all specifications considered in Table 5 and Table 6, albeit imprecisely measured. Interestingly, the pattern of statistical significance, with coefficients becoming more significant after $h=6$, now closely resembles that of the direct holdings by the financial sector. This further strengthens our interpretation that much of the risk attributed to the financial sector ultimately stems from a shift toward less liquid assets, which are increasingly funded by the more volatile foreign sector.

Overall, we find that loan-bond substitution by the government and the associated reallocation towards loans on the asset side of other sectors is linked to an increase in financial distress, in particular when volatile funding is channeled into loans via domestic financial intermediaries.

5. Credit rating surprises and the macroeconomy

In the previous section, we have established that credit rating downgrades for poorly rated countries are linked to subsequent loan-bond substitution, which has negative implications for financial stability. Next, we estimate the real macroeconomic effects of such credit downgrades. Our results show that credit rating downgrades for poorly rated countries are followed by a severe economic contraction. To address the challenge that rating downgrades could be anticipated, we propose a new measure of credit rating surprises as an instrumental variable. The instrumental variable approach successfully eliminates pre-trends. Moreover, a comparison with least squares estimates shows that the different estimators yield similar effects after adverse credit rating changes, suggesting that anticipation bias in the least squares estimates may be quantitatively negligible.

5.1. Credit rating surprises

Econometric specification. Sovereign credit ratings inform creditors about the likelihood of future repayment problems of governments. Therefore, these ratings are inherently forward looking and should critically depend on the economic outlook. This implies that forecasts about economic fundamentals should predict rating changes. We leverage that insight to construct a measure of rating surprises following a similar approach as Romer and Romer (2004) applied to monetary policy interest rate changes. To do so, we regress changes in the rating index on a set of lagged forecasts and macroeconomic variables. The resulting regression residual captures a rating surprise that is plausibly orthogonal to economic fundamentals. Specifically, we estimate

$$\Delta_1 Rating_{i,t} = \beta_i + \sum_{h=-1}^{2} \left(\beta_1 x^{fc}_{i,t-1,h} + \beta_2 \Delta x^{fc}_{i,t-1,h} \right) + \beta_3 x_{i,t-1} + \beta_4 \Delta x_{i,t-1} + \varepsilon^{rs}_{i,t}, \tag{7}$$

where $\varepsilon^{rs}_{i,t}$ is the error term and the outcome, $\Delta_1 Rating_{i,t}$, is the first-difference of the rating index that we project on a country-specific intercept, and on two sets of regressors. The first regressor vector, $x^{fc}_{i,t-1,h}$, comprises macroeconomic forecasts from the IMF World Economic Outlook. The second regressor vector, $x_{i,t-1}$, contains additional macroeconomic variables.

Control variables. The vector $x^{fc}_{i,t-1,h}$ contains forecasts for GDP growth, inflation, and the current account, relative to GDP. The current account forecast may be important because current account deficits often precede downgrades and crises. Similar to Romer and Romer (2004), we consider four

distinct forecast horizons, starting with the "backcast" about the previous 12 months ($h = -1$), and forecast for the next 12 months ($h = 0$), as well as forecasts for 12 to 24 ($h = 1$) and 24 to 36 ($h = 2$) months out. In the appendix, we provide additional details about these forecasts. All forecasts enter the regression in levels and first differences, similar to Romer and Romer (2004). However, different from them, we always use forecasts lagged by one quarter to ensure that they are compiled before a rating change materializes to mitigate reverse causality concerns.[23]

The second set of variables includes credit ratings and the ten-year government bond yield. Lagged credit ratings are included to capture serial correlation in the rating itself, whereas the ten-year government bond yields capture investors beliefs about creditworthiness via risk premia. Further, we also include total government debt, as well as government loans and bonds separately, all relative to GDP. We do so because the stock of government debt and its composition may be a critical determinant of a country's creditworthiness (e.g., Reinhart and Rogoff, 2010). As for forecasts, we exclusively use lagged variables in levels and first differences to only include information available prior to a rating change.[24]

Results. The regression yields an R^2 of 0.25, which is relatively close to the value reported in Romer and Romer (2004), although their analysis focuses on interest rate changes. Similar to them, we are not interested in the regression coefficients, which are difficult to interpret, as many variables are highly correlated. This is particularly true for forecasts over different horizons and for levels vs first-differences. Instead, we are interested in the regression residual $\hat{\varepsilon}^{rs}_{i,t}$ to construct an instrumental variable for our key regressors, $DR_{i,t} \times BAR_{i,t}$, that captures rating downgrades for below-average rated countries. Specifically, we construct this instrumental variable as $DR^{IV}_{i,t} \times BAR_{i,t}$ that takes a non-zero value whenever $DR_{i,t} \times BAR_{i,t}$ is non-zero. The variable $DR^{IV}_{i,t}$ is then defined as being unity whenever $\hat{\varepsilon}^{rs}_{i,t} < 0$ and zero otherwise, in line with the definition of $DR_{i,t}$ in Equation 3.

5.2. First stage and validation

First stage We estimate the effects of credit downgrades for below-average rated countries using the specification from Equation 5 in section 4. The only critical difference is that we use our instrumental variable, $DR^{IV}_{i,t} \times BAR_{i,t}$, to instrument the corresponding regressor of interest. The

[23] Romer and Romer (2004) have central bank forecasts that are typically compiled in the same period as the policy decision. However, in their setting, it is known that the forecasts are prepared before the policy decision because these forecasts are an input to the policy decision itself. Unfortunately, we do not have the forecasts of rating agencies before credit rating changes at our disposal. Thus, we follow the conservative approach of only including lagged forecasts.

[24] Since the stock of debt has been linearly interpolated from annual data, we take a four-quarter lag of all debt stock variables to ensure that they are predetermined with respect to the rating change on the left-hand side of Equation 7.

Table 7: *First stage results using rating surprises*

	$DR_{i,t} \times BAR_{i,t}$			
	(1)	(2)	(3)	(4)
$DR^{IV}_{i,t} \times BAR_{i,t}$	0.504***		0.518***	
	(0.065)		(0.062)	
$DR_{i,t}$	0.254***	0.448***	0.242***	0.444***
	(0.075)	(0.087)	(0.070)	(0.087)
$IR_{i,t} \times BAR_{i,t}$	-0.169***	-0.149***	-0.164***	-0.146***
	(0.022)	(0.029)	(0.022)	(0.029)
$IR_{i,t}$	0.018**	0.029***	0.024***	0.036***
	(0.007)	(0.009)	(0.007)	(0.009)
$BAR_{i,t}$	0.216***	0.360***	0.222***	0.389***
	(0.048)	(0.077)	(0.050)	(0.091)
Lagged control variables			✓	✓
Country fixed effects	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓
F statistic	216.83	37.49	134.31	29.78
R^2	0.74	0.55	0.76	0.57
Observations	1981	1981	1950	1950

Notes: This table presents quarterly first stage regression results based on Equation 5. The dependent variables is $DR_{i,t} \times BAR_{i,t}$, an indicator that is activated when a below-average rated country gets downgraded. In columns (1) and (3) we present proper first stage regressions using our instrumental variable, $DR^{IV}_{i,t} \times BAR_{i,t}$, based on the credit rating surprises as introduced in subsection 5.1. In columns (2) and (4), respectively, we display the correspond regression models but exclude our instrumental variable. $DR_{i,t}$, $IR_{i,t}$, and $BAR_{i,t}$ refer to indicator variables for government credit rating decreases, increases, and a below-average rating level, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

first stage estimation results are in Table 7 with standard errors in parentheses being clustered at the country and time level. Columns (1) and (2) provide a parsimonious specification where we omit the lagged control variables, as specified in section 4.[25] Column (1) displays the proper first stage that uses our instrument. The instrumental variable is statistically significant at all conventional levels and displays the expected sign. The regression also explains a sizable fraction of the variation in $DR_{i,t} \times BAR_{i,t}$ as shown by the R^2. Similarly, the F statistic of almost 200 is extraordinarily large, indicating that we have a strong instrument. For comparison, column (2) displays the same regression but omits our instrumental variable. This omission leads to a large drop in both R^2 and F statistic, suggesting that our instrumental variable drives the strong first stage. In columns (3) and (4), we show the same results for the baseline setup, which includes the lagged control variables. The regression results are very similar, allowing us to conclude that the instrument is strong.

Validation. Before moving to the macroeconomic effects, we conduct a validation exercise. Specifically, we re-estimate the responses of the loan-bond ratio and the ten-year government bond yield

[25] Recall that the control variables are a one-quarter lag of real GDP growth, the ten-year government bond yield, the change in the rating index, and the log price level.

using ordinary least squares and our instrumental variable separately and analyze the pre-trends by using lags instead of leads on the left-hand side ($h < -1$). We also compare least squares and instrumental variable estimates for leads ($h \geq 0$) to check whether the results presented in section 4 are partly driven by the predictability of rating downgrades.

The results are displayed in Figure 7. The solid red line shows the instrumental variable estimates corresponding to $DR_{i,t} \times BAR_{i,t}$ and the shaded areas provide confidence bands at the 68% and 95% level. Likewise, the bold-dashed black line displays the corresponding least squares estimates and the thin gray lines indicate 68% and 95% confidence bands. All displayed confidence bands are based on standard errors clustered at the country and time level.

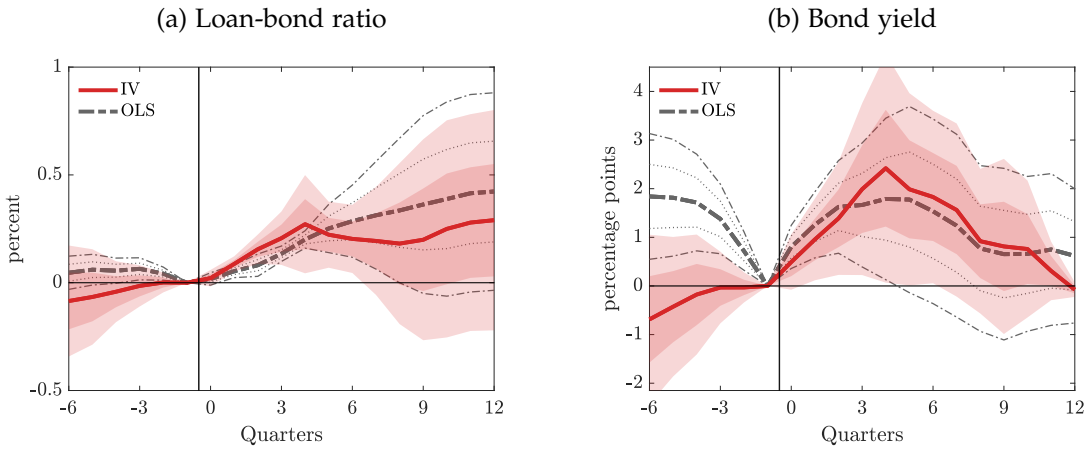
The instrumental variable estimates display virtually no pre-trends. The point estimates are close to zero and never statistically different from zero, not even at the 68% confidence level. In comparison, we do find pre-trends for the least squares estimates. The loan-bond pre-trend is moderate in size but still statistically significant at the 5% level for two quarters. The pre-trend for bond yields is more striking. It is of similar magnitude as the estimated effects past a downgrade and it is statistically significant at all conventional levels for all pre-trend horizons. This comparison of pre-trends suggests that our instrumental variable approach successfully eliminates predictability of our regressor of interest, $DR_{i,t} \times BAR_{i,t}$.

Ex-ante, the least squares pre-trends raise the concern that the results from section 4 could be biased because the regressor of interest is predictable. However, the comparison of the instrumental variable and least squares estimates after downgrades shows that both are similar in magnitude. This ex-post finding alleviates the concerns that a large predictability bias plagues our least squares results. Finally, a potential concern with this conclusion is that our instrumental variable might still violate the exclusion restriction. However, we view this as less likely given that instrumental variable eliminates pre-trends entirely.

5.3. Macroeconomic consequences of credit downgrades

Real GDP. Given that the instrumental variable approach successfully eliminates pre-trends, we now move to studying the macroeconomic consequences of credit rating downgrades for countries that are rated below the average. We maintain the same specification as in the previous section but study the natural logarithm of real GDP, real consumption, real investment, and real government spending as outcomes. Specifically, the left-hand side of the regression is a long difference of the outcome, relative to $t-1$ and identical to the setup for the loan-bond ratio or the bond yield. Thus,

Figure 7: *Responses of the loan-bond ratio and government bond yields to $DR_{i,t} \times BAR_{i,t}$*



Notes: This figure presents quarterly responses based on the regression in Equation 5. The dependent variables are changes between $t-1$ and $t+h$, where h is indicated on the horizontal axis. The variables are loan-bond ratio and the ten-year government bond yield, in Panels (a) and (b), respectively. The displayed estimates correspond to $DR_{i,t} \times BAR_{i,t}$, an indicator that is activated when a below-average rated country gets downgraded. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. The shaded ares are confidence bands at the 68 and 95 percent level, based on standard errors clustered by country and time.

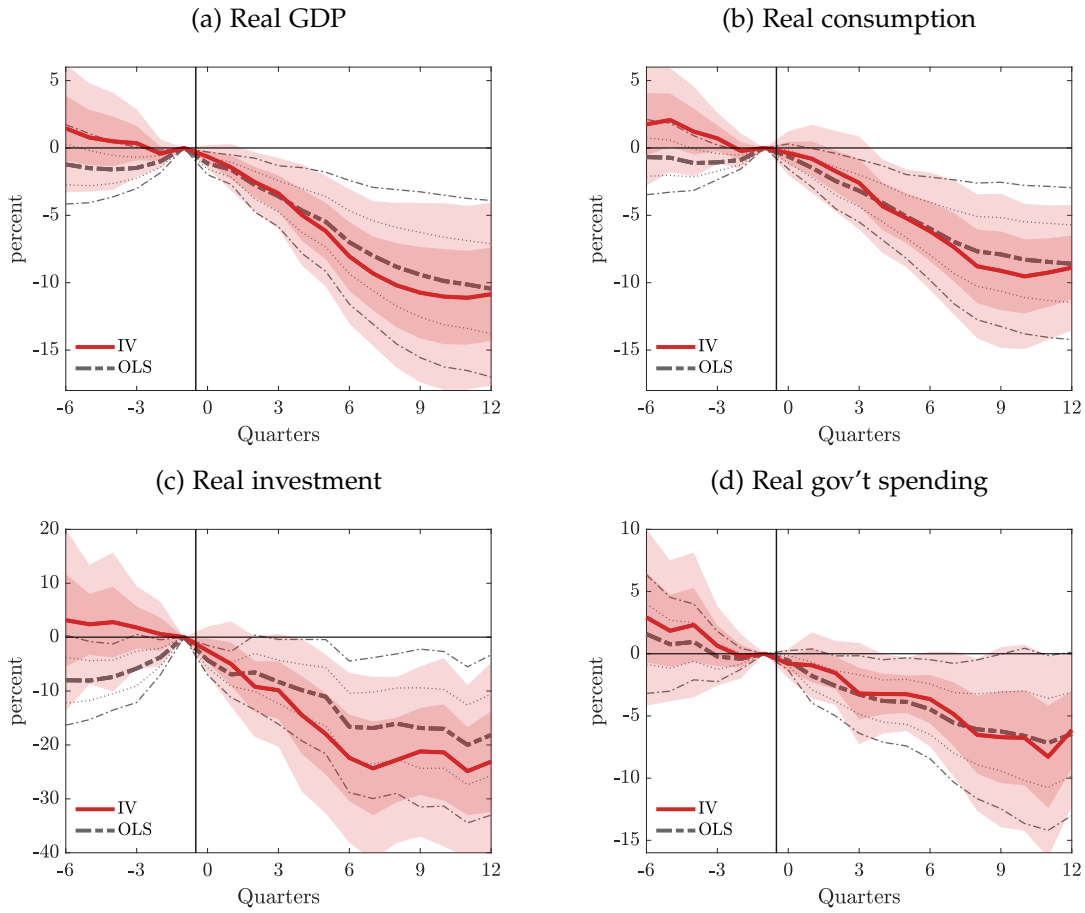
we effectively study the dynamic responses of cumulative growth rates.

The results are displayed in Figure 8 with standard errors and confidence bands being constructed as before. The instrumental variable estimates display no pre-trends whatsoever. In contrast, the least squares estimates show some pre-trends, albeit less pronounced than for bond yields. The estimated dynamic effects after downgrades are comparable in magnitude, irrespective of whether or not we use our instrumental variable. Thus, the subsequent discussion does not discriminate between both approaches.

Following the credit downgrade, we find a severe contraction of real GDP, as shown in Panel (a). This contraction builds up over time and levels off after around two years with cumulative GDP growth being ten percent lower due to the credit rating downgrade. While year-over-year GDP growth might return to the pre-downgrade rate, there is a permanent level-shift in GDP. Similar patterns have been documented in the raw time series around the Great Financial Crisis for the United States and the European Union (see, e.g., Figure 1 from Benigno and Fornaro, 2018).

Real GDP components. To further understand the drivers of the GDP effects, we present the responses of real consumption, investment, and government spending in Panels (b) to (d) of Figure 8. The overall pattern of the dynamic responses of all three variables is similar to real GDP. Compared with the GDP effects, we find that the consumption response is slightly weaker and more delayed, possibly reflecting consumption smoothing. In contrast, investment responds substantially

Figure 8: *Responses of real macroeconomic outcomes to $DR_{i,t} \times BAR_{i,t}$*



Notes: This figure presents quarterly responses based on the regression in Equation 5. The dependent variables are changes between $t-1$ and $t+h$, where h is indicated on the horizontal axis. The variables are the log of real GDP, real private consumption, real private investment, and real government spending, in Panels (a) to (d), respectively. The displayed estimates correspond to $DR_{i,t} \times BAR_{i,t}$, an indicator that is activated when a below-average rated country gets downgraded. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. The shaded ares are confidence bands at the 68 and 95 percent level, based on standard errors clustered by country and time.

stronger than GDP reflecting the fact that investment is the most volatile component of aggregate demand, and the one most likely to immediately react to changes in borrowing costs for the economies safest asset (Almeida et al., 2017). Both consumption and investment become statistically significant at all conventional levels after about one year. Lastly, we find similar patterns for real government spending, albeit less precisely measured: While the instrumental variable estimates are only significant at the ten percent level for most horizons, we find that the least squares estimates are still statistically significant at the five percent level for many response horizons.

Taken together, we conclude that credit rating downgrades for countries that have been rated below average has a detrimental effect on real GDP over medium term horizons, which is particularly driven by a reduction in private investment. This is consistent with increased financial distress due

to private balance sheets containing less liquid government loans instead of bonds on the asset side. Finally, we acknowledge that credit downgrades likely affect the real economy through various additional channels beyond the increasing cost of government debt, loan-bond substitution and balance sheet exposure.

6. Conclusion

In this paper, we connect two previously distinct sources of data: information on government credit ratings and the funding structure of government debt. In doing so, we offer a novel and comprehensive perspective on sovereign debt composition in advanced economies, highlighting the understudied role of loans alongside traditional bond financing, and the circumstances under which governments may come to rely on them.

Using detailed data on sectoral balance sheets from the OECD financial accounts and a newly constructed index of sovereign credit ratings, we document three key insights: (i) sovereigns adjust the composition of their debt in response to rating changes, with significant substitution from bonds to loans following downgrades; (ii) this substitution is concentrated among countries already rated below average, for whom bond yields increase disproportionately; (iii) rating downgrades and loan-bond substitution have significant implications for the broader macroeconomy. We find financial distress to increase after a rise in the loan-bond ratio in government liabilities. By unveiling the ultimate counterparties financing government debt, we further show that rising financial distress is driven particularly by a shift towards loans ultimately financed by the foreign sector. This coincides with a significant decline in GDP growth after downgrades in countries already rated below average, indicating real economic costs associated with deteriorating credit ratings.

Overall, our findings underscore the importance of credit ratings, not only for the more widely studied bond yields, but also for the structure of sovereign debt. These insights may be relevant to policymakers, as they suggest that maintaining investor confidence affects not only the government's cost of borrowing, but also the stability of the domestic financial system through changes in the balance sheets of the sectors holding government debt. More generally, a better understanding of how credit rating changes propagate through the structure of sovereign debt to the real economy can help inform macroprudential regulation and fiscal planning.

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Appendix

Loanly Governments:
Sovereign Debt in the Wake of Credit Rating Downgrades

A. Appendix

A1. Data

Table A1.1: *Sample coverage by country*

Country	(1) OECD Flows	(2) OECD Balances	(3) Ratings	(4) Yields	(5) Inflation	(6) WEO	(7) Distress
Australia	-	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2017
Austria	1995-2018	1996-2018	1996-2018	1996-2018	1996-2018	1996-2018	1996-2017
Belgium	1973-2018	1974-2018	1988-2018	1974-2018	1974-2018	1990-2018	1974-2017
Canada	1970-2018	1975-2018	1975-2018	1975-2018	1975-2018	1990-2018	1975-2017
Chile	1990-2018	2003-2018	2003-2018	2004-2018	2003-2018	2003-2018	-
Colombia	1997-2018	1997-2018	1997-2018	2003-2018	1997-2018	1997-2018	-
Czech Republic	1993-2018	1995-2018	1995-2018	2000-2018	1995-2018	1995-2018	2003-2017
Denmark	1995-2018	1995-2018	1995-2018	1995-2018	1995-2018	1995-2018	1995-2017
Estonia	1995-2018	1996-2018	1997-2018	1997-2018	1998-2018	1996-2018	-
Finland	1987-2018	1981-2018	1981-2018	1988-2018	1981-2018	1990-2018	1981-2017
France	1977-2018	1978-2018	1978-2018	1978-2018	1978-2018	1990-2018	1978-2017
Germany	1973-2018	1974-2018	1983-2018	1974-2018	1974-2018	1990-2018	1974-2017
Greece	1995-2018	1996-2018	1999-2018	1997-2018	1996-2018	1996-2018	1996-2017
Hungary	1991-2018	1992-2018	1992-2018	1999-2018	1992-2018	1992-2018	1998-2017
Ireland	1999-2018	1999-2018	1999-2018	1999-2018	1999-2018	1999-2018	1999-2017
Israel	2011-2018	2002-2017	2002-2017	2002-2017	2002-2017	2002-2017	-
Italy	1980-2018	1980-2018	1986-2018	1991-2018	1980-2018	1990-2018	1980-2017
Japan	1973-2018	1974-2018	1974-2018	2002-2018	1974-2018	1990-2018	1974-2017
Latvia	1995-2018	1996-2018	1997-2018	2001-2018	1996-2018	1996-2018	-
Lithuania	1995-2018	1996-2018	1996-2018	2001-2018	1996-2018	1996-2018	-
Netherlands	1988-2018	1991-2018	1991-2018	1991-2018	1991-2018	1991-2018	1991-2017
New Zealand	-	2008-2017	2008-2017	2008-2017	2008-2017	2008-2017	2008-2017
Norway	1995-2018	1982-2018	1982-2018	1985-2018	1982-2018	1990-2018	1982-2017
Poland	1995-2018	1996-2018	1996-2018	2001-2018	1996-2018	1996-2018	1998-2017
Portugal	1995-2018	1996-2018	1996-2018	1996-2018	1996-2018	1996-2018	1996-2017
Slovakia	1995-2018	1996-2018	1996-2018	2000-2018	1996-2018	1996-2018	2003-2017
Slovenia	1995-2018	1996-2018	1996-2018	2002-2018	1996-2018	1996-2018	-
South Korea	2003-2018	2003-2018	2003-2018	2003-2018	2003-2018	2003-2018	2003-2017
Spain	1981-2018	1974-2018	1988-2018	1980-2018	1974-2018	1990-2018	1974-2017
Sweden	1995-2018	1981-2018	1981-2018	1987-2018	1981-2018	1990-2018	1981-2017
Switzerland	2000-2018	2000-2018	2000-2018	2000-2018	2000-2018	2000-2018	2000-2017
United Kingdom	1987-2018	1988-2018	1988-2018	1988-2018	1988-2018	1990-2018	1988-2017
United States	1970-2018	1974-2018	1974-2018	1974-2018	1974-2018	1990-2018	1974-2017

Notes: This table shows our sample coverage by country. Columns (1) and (2) refer to flows and balances, respectively, and indicate the years for which both bond and loan data are available for the respective item in the OECD's financial accounts. Column (3) refers to our rating index, constructed as an average across rating agencies. Columns (4) and (5) refer to government bond yields (defined here as including both long- and short-term yields) and inflation, both sourced from the OECD data warehouse. Column (6) refers to the World Economic Outlook (WEO) of the IMF, which includes forecasts of GDP, inflation, and the current account. Column (7) refers to the financial distress measure by Romer and Romer (2017).

Figure A1.1: *Current credit ratings of the United States (November 2024), for different agencies*

Grade	Description	S&P	Moody's	Fitch	DBRS
Investment Grade	Prime	AAA	Aaa	AAA	AAA
	High Medium Grade	AA+	Aa1	AA+	AA(high)
		AA	Aa2	AA	AA
		AA-	Aa3	AA-	AA(low)
	Upper Medium Grade	A+	A1	A+	A(high)
		A	A2	A	A
		A-	A3	A-	A(low)
	Lower Medium Grade	BBB+	Baa1	BBB+	BBB(high)
		BBB	Baa2	BBB	BBB
		BBB-	Baa3	BBB-	BBB(low)
Speculative Grade	Speculative	BB+	Ba1	BB+	BB(high)
		BB	Ba2	BB	BB
		BB-	Ba3	BB-	BB(low)
	Highly Speculative	B+	B1	B+	B(high)
		B	B2	B	B
		B-	B3	B-	B(low)
	Substantial Risk	CCC+	Caa1	CCC+	CCC(high)
		CCC	Caa2	CCC	CCC
		CCC-	Caa3	CCC-	CCC(low)
	Extremely Speculative	CC	Ca	CC	CC
		C	C	C	C
	In Default	RD	/	RD	RD
		SD	/	SD	SD
		D•NR	D•NR	D•NR	D•NR

Notes: This figure shows the rating scale of the top 4 rating agencies, used to construct our composite rating index, as described in section 2. The shown table is a snapshot from the website of World Government Bonds Credit Ratings (2024) and highlights the current credit rating of the United States (as of November 2024) in green. Positive and negative outlooks are represented by red and green dots respectively.

Forecast construction. The IMF World Economic Outlook (WEO) releases macroeconomic forecasts twice per year and the forecast variables that we consider are GDP growth, CPI inflation, and the current account relative to GDP, all for calendar years. Specifically, at each release, there is a forecast for the current and for future calendar years, as well as backcasts for past calendar years. The WEO is typically released beginning of April and October. Thus, we obtain forecasts in the second and fourth quarter of each year. To obtain forecasts also in the first and third quarter, we assume that missing forecasts take the value of the most recent previous forecast. We do so to not introduce future information. Finally, we take linear combination of these calendar year forecasts to obtain forecasts with a fixed 12-month horizon. For example, for the 12-month ahead forecast ($h = 0$), we define $x^{fc}_{i,t,0} = (1 - q(t)/4)\ \tilde{x}^{fc}_{i,t,\tau(t)} + q(t)/4\ \tilde{x}^{fc}_{i,t,\tau(t)+1}$, where $\tilde{x}^{fc}_{i,t,\tau}$ is the calendar year forecast released at t containing the forecast for year $\tau(t)$, and $q(t) \in \{1, 2, 3, 4\}$ denotes the quarter of t. The other forecast horizons are defined analogously.

A2. Model Derivations

The following first-order conditions characterize the government's optimal portfolio choice,

$$\mathcal{L}\, c(\omega) = r(b) - r(\ell) + br'(b) - \ell r'(\ell) \qquad \text{and} \qquad d = \ell + b. \tag{8}$$

Imposing the linearity assumption $r(x) = x/2$, as stated in the main text, yields the following expression for the loan-bond ratio,

$$\mathcal{R} = \frac{d - \mathcal{L}\, c(\omega)}{d + \mathcal{L}\, c(\omega)}. \tag{9}$$

Proof of Proposition Convexity Differentiating $\mathcal{R}$ with respect to ω yields

$$\frac{\partial \mathcal{R}}{\partial \omega} = \frac{-2d\mathcal{L}\, c'(\omega)}{\left(d + \mathcal{L}\, c(\omega)\right)^2} < 0, \tag{10}$$

since $d > 0$, $\mathcal{L} > 0$, and $c' > 0$. The second derivative with respect to ω satisfies

$$\frac{\partial^2 \mathcal{R}}{\partial \omega^2} \propto \left[-c''(\omega)\left(d + \mathcal{L}\, c(\omega)\right) + 2\mathcal{L}^2\left(c'(\omega)\right)^2\right]\left(d + \mathcal{L}\, c(\omega)\right) > 0 \tag{11}$$

due to $c'' \leq 0$, $c' > 0$, and $\mathcal{L} > 0$.

A3. Additional Results and Robustness

Table A3.2: *Government bond yields and newly issued debt in response to rating changes. Central government only*

	Δ_5 Bond yield$_{i,t+4}$			$\Sigma_{j=0}^{4}$ Bond Issuance$_{i,t+j}$			$\Sigma_{j=0}^{4}$ Loan Issuance$_{i,t+j}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$DR_{i,t} \times BAR_{i,t}$	1.436**	1.524**		-3.441***	-3.447***		3.089**	3.270**	
	(0.684)	(0.717)		(1.142)	(1.190)		(1.210)	(1.238)	
$DR_{i,t}$	0.417**	0.413*		1.746***	1.758***		0.661	0.647	
	(0.203)	(0.203)		(0.507)	(0.518)		(0.618)	(0.616)	
$IR_{i,t} \times BAR_{i,t}$	-0.287*		-0.627**	0.153		0.619	-0.655		-1.358**
	(0.152)		(0.278)	(0.529)		(0.609)	(0.400)		(0.608)
$IR_{i,t}$	-0.001		0.049	-0.207		-0.384	0.106		0.219
	(0.080)		(0.084)	(0.443)		(0.447)	(0.217)		(0.245)
$BAR_{i,t}$	-0.475	-0.534	0.262	4.425**	4.456**	3.339	-1.296	-1.431	0.231
	(0.599)	(0.611)	(0.507)	(2.052)	(2.046)	(2.040)	(1.087)	(1.083)	(1.428)
R^2	0.548	0.546	0.507	0.475	0.474	0.463	0.492	0.491	0.467
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2591	2591	2591	2591	2591	2591	2591	2591	2591

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables are the change in the ten-year government bond yield between $t-1$ and $t+4$ in columns (1) to (3), the cumulative issuance of new central government bonds relative to GDP from t to $t+4$ in columns (4) to (6), and the cumulative new issuance of central government loan liabilities relative to GDP over the same period in columns (7) to (9). This is in contrast to using the entire (general) government in our baseline in Table 2, and, for columns (1) to (3), leads to a changing sample for government bond yields. $DR_{i,t}$, $IR_{i,t}$, and $BAR_{i,t}$ refer to indicator variables for government credit rating decreases, increases, and a below-average rating level, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

Table A3.3: *Changes in government liability composition and total outstanding debt in response to rating changes. Central government only*

	Δ_5 Loan-bond ratio$_{i,t+4}$			Δ_5 Total gov. debt$_{i,t+4}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$DR_{i,t} \times BAR_{i,t}$	0.222**	0.273**		0.548	0.666	
	(0.086)	(0.124)		(1.404)	(1.580)	
$DR_{i,t}$	-0.034	-0.043		2.155**	2.171**	
	(0.045)	(0.052)		(0.824)	(0.823)	
$IR_{i,t} \times BAR_{i,t}$	-0.226		-0.266	-0.096		-0.443
	(0.204)		(0.217)	(1.024)		(1.217)
$IR_{i,t}$	0.095		0.104	-0.401		-0.468
	(0.110)		(0.115)	(0.585)		(0.589)
$BAR_{i,t}$	-0.230	-0.278	-0.143	0.393	0.367	1.161
	(0.147)	(0.188)	(0.137)	(2.054)	(2.063)	(2.251)
R^2	0.228	0.228	0.228	0.394	0.394	0.394
Country fixed effects	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓
Observations	2949	2949	2949	2949	2949	2949

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables are the change in the loan-bond ratio in central government liabilities between $t-1$ and $t+4$ in columns (1) to (3), and the change in the amount of total outstanding central government debt relative to GDP between $t-1$ and $t+4$ in columns (4) to (6). This is in contrast to using the entire (general) government in our baseline in Table 3. $DR_{i,t}$, $IR_{i,t}$, and $BAR_{i,t}$ refer to indicator variables for government credit rating decreases, increases, and a below-average rating level, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

Table A3.4: *New government debt issuance and changes in outstanding government debt in response to rating changes. Shifting time horizons*

	$\Sigma_{j=0+h}^{4+h}$ Bond Issuance$_{i,t+j}$				$\Sigma_{j=0+h}^{4+h}$ Loan Issuance$_{i,t+j}$				Δ_5 Total Gov. Debt$_{i,t+4+h}$			
	h=-1	*h=0*	*h=1*	*h=2*	*h=-1*	*h=0*	*h=1*	*h=2*	*h=-1*	*h=0*	*h=1*	*h=2*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$DR_{i,t} \times BAR_{i,t}$	-3.27***	-3.52***	-3.65**	-3.51**	2.73**	3.03**	3.11*	2.92	-0.54	0.37	1.02	1.31
	(0.93)	(1.12)	(1.36)	(1.51)	(1.06)	(1.24)	(1.54)	(1.79)	(1.55)	(1.44)	(1.39)	(1.47)
$DR_{i,t}$	2.11***	1.95***	1.64***	1.31**	0.42	0.68	1.03	1.40	2.78**	2.81***	2.92***	3.21***
	(0.53)	(0.53)	(0.52)	(0.55)	(0.38)	(0.53)	(0.71)	(0.89)	(1.04)	(1.02)	(1.03)	(1.09)
$IR_{i,t} \times BAR_{i,t}$	0.19	0.49	0.82	1.16**	-0.49	-0.65*	-0.87**	-1.00*	0.17	0.16	0.18	0.37
	(0.50)	(0.49)	(0.49)	(0.49)	(0.34)	(0.37)	(0.42)	(0.52)	(0.97)	(0.94)	(0.90)	(0.90)
$IR_{i,t}$	-0.28	-0.42	-0.63	-0.83**	0.02	0.07	0.09	0.09	-0.74	-0.93*	-1.19**	-1.42***
	(0.43)	(0.41)	(0.39)	(0.40)	(0.19)	(0.19)	(0.17)	(0.17)	(0.50)	(0.49)	(0.47)	(0.45)
$BAR_{i,t}$	3.31*	3.34*	3.38*	3.34	-0.94	-0.97	-1.03	-1.02	0.11	-0.20	-0.55	-0.89
	(1.84)	(1.90)	(1.97)	(2.00)	(0.87)	(1.06)	(1.26)	(1.37)	(1.68)	(1.68)	(1.83)	(2.08)
R^2	0.469	0.462	0.454	0.444	0.519	0.480	0.439	0.401	0.540	0.537	0.530	0.521
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2816	2799	2782	2764	2816	2799	2782	2764	2816	2799	2782	2764

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables are the cumulative issuance of new government bonds in columns (1) to (4), the cumulative issuance of new government loan liabilities in columns (5) to (8), and the change in the total amount of outstanding government debt in columns (9) to (12), all relative to GDP. Relative to our baseline specification for these variables in Table 2 and Table 3, this table shifts the outcome variables across different horizons (quarters) $h \in -1, 0, 1, 2$, where $h = 0$ corresponds to the baseline specification: cumulative bond and loan issuance from t to $t + 4$, and changes in outstanding government debt from $t - 1$ to $t + 4$, respectively. $DR_{i,t}$, $IR_{i,t}$, and $BAR_{i,t}$ refer to indicator variables for government credit rating decreases, increases, and a below-average rating level, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.

Table A3.5: *New government debt issuance and changes in outstanding government debt in response to rating changes. Different BAR definitions*

	$\Sigma_{j=0+h}^{4+h}$ Bond Issuance$_{i,t+j}$			$\Sigma_{j=0+h}^{4+h}$ Loan Issuance$_{i,t+j}$			Δ_5 Total Gov. Debt$_{i,t+4}$		
$BAR_{i,}$:	t	$t-1$	$t\|t-1\|t-2\|t-3$	t	$t-1$	$t\|t-1\|t-2\|t-3$	t	$t-1$	$t\|t-1\|t-2\|t-3$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$DR_{i,t} \times BAR$	-3.52***	-3.52***	-3.49***	3.03**	2.59*	3.03**	0.37	-0.30	0.43
	(1.12)	(1.05)	(1.14)	(1.24)	(1.28)	(1.24)	(1.44)	(1.57)	(1.44)
$DR_{i,t}$	1.95***	1.94***	1.94***	0.68	0.96	0.68	2.81***	3.16***	2.79***
	(0.53)	(0.54)	(0.53)	(0.53)	(0.62)	(0.53)	(1.02)	(1.12)	(1.01)
$IR_{i,t} \times BAR$	0.49	0.54	0.55	-0.65*	-0.67*	-0.67*	0.16	0.17	0.23
	(0.49)	(0.49)	(0.52)	(0.37)	(0.37)	(0.37)	(0.94)	(0.93)	(0.95)
$IR_{i,t}$	-0.42	-0.49	-0.51	0.07	0.07	0.10	-0.93*	-0.97*	-0.98*
	(0.41)	(0.41)	(0.40)	(0.19)	(0.18)	(0.18)	(0.49)	(0.48)	(0.49)
BAR	3.34*	3.38*	3.28*	-0.97	-1.23	-0.97	-0.20	-0.59	-0.34
	(1.90)	(1.93)	(1.93)	(1.06)	(0.97)	(1.08)	(1.68)	(1.67)	(1.72)
R^2	0.462	0.462	0.461	0.480	0.478	0.479	0.537	0.537	0.537
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2799	2799	2799	2799	2799	2799	2799	2799	2799

Notes: This table presents quarterly regression results based on Equation 5, as specified in the text. The dependent variables are the cumulative issuance of new government bonds in columns (1) to (3), the cumulative issuance of new government loan liabilities in columns (4) to (6), and the change in the total amount of outstanding government debt in columns (7) to (9), all relative to GDP. Cumulative bond and loan issuance are computed from t to $t+4$, and changes in outstanding government debt from $t-1$ to $t+4$, respectively. Relative to our baseline specification for these variables in Table 2 and Table 3, this table uses alternative classifications for below average rated countries $BAR_{i,t}$, with columns (1), (4) and (7) showing out baseline indicator for comparison. Columns (2), (5), and (8) use the first lag of the $BAR_{i,t}$ indicator, ensuring that it is pre-determined relative to any rating change between $t-1$ and t. Columns (3), (6), and (9) consider a BAR indicator that is activated when a country has been rated below average at any point in quarters $t \in -3, -2, -1, 0$. $DR_{i,t}$ and $IR_{i,t}$, refer to indicator variables for government credit rating decreases and increases, respectively. Controls include a quarterly lag of real GDP growth, the ten-year government bond yield, the rating index, and the natural logarithm of the price level based on the CPI. All specifications additionally include country and time fixed effects. Standard errors are in parenthesis and clustered by country and year, and *,**,*** indicates significance at the 0.1, 0.05, 0.01 levels, respectively.