The Effect of Information and Risk on the Ownership Structure of Government Bond Markets

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Abstract

Bonds are one of the most important sources of funding for modern governments, but we understand little about the causes of various ownership distributions of government bonds. The market power of individual bond market investors is important because bond markets can affect government fiscal policy. If investors are rational, then similar securities should have similar ownership structures and therefore similar distributions of market power across their investors. But this isn't always the case. I argue that this variation in market power occurs because more risk-accepting investors are more willing to pay discovery costs about debtor willingness/ability to repay, but only in risky assets. In highly rated assets, the market has little doubt about debtor ability or willingness to repay and doesn't need to invest in further information about debt repayment capacity. But in lower-credit assets, this variation in market power exists because firms with higher risk thresholds are more willing to invest in costly information about the debtor government's ability and willingness to repay its debt and accrue larger positions as a result. As a result, I hypothesize that more risk-accepting investors will accrue larger positions in riskier securities because they are more willing to pay for information about debtor ability/willingness to repay. Sourcing enterprise-quality data on individual securities from multiple financial data providers, I find support for my hypothesis in European sovereign debt using time-series econometric methods. This paper contributes a clear theoretical discussion of the causes of market power in government bond markets. This dynamic is important to political actors because it is linked to government fiscal outcomes through debt restructurings and bond market pressure.

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1 Introduction

Countries fund themselves with money from a variety of sources, including taxation, loans, state-owned assets, and borrowing money on financial markets. Since the Brady debt restructurings in the 1990s, countries have increasingly relied on issuing bonds for funding, which makes the connection between governments and financial market participants increasingly important. The extent to which movements in these markets affect government policy is relatively understudied.[1] That creditors had enough market power over the Argentine government to (temporarily) impound an Argentinian naval frigate during debt restructuring negotiations shows that this topic matters to governments, investors, and financial intermediaries (Stevenson, 2016).

Investors can exert market power over debt-issuing governments in several ways. More market power makes it easier for debtholders to meet the thresholds included in the Collective Action Clauses (CACs) of government debt securities and therefore to negotiate favorable terms in debt restructuring deals (Gulati and Buchheit, 2009). An investor could also exert market power via pricing: by strategically selling holdings, investors can influence asset price, pushing up the issuing government's cost of borrowing over the long term.[2]

Financial market influence over government policy is rooted in individual investor policy preferences and market power. If investors were rational, their movements would be governed by risk-weighted expected return r, so two bonds with the same r should have similar ownership structures and the distribution of market power across their debt holders should be relatively similar. Market power in the abstract can be difficult to measure, but a security's ownership structure is a close proxy.

For example, consider the Italian and Portuguese ten-year government bonds. Both countries use the same currency, have the same credit rating, and their securities have similar returns. Assuming that the risk-weighted return compensates the owners for default risk, liquidity risk, and other financial risks, investors should treat the two assets identically and they should exhibit the same ownership structure. But that's not what we see; instead, the Italian bond is more than twice as concentrated as the Portuguese bond.[3] Why do government bonds that are otherwise similar have such drastically different ownership structures?

I argue that this variation in market power occurs because investor willingness to pay discovery costs about debtor willingness/ability to repay increases with risk acceptance for risky assets (Calvo and Mendoza, 2000; Autor, 2001). In highly rated assets, the market has little doubt about debtor ability or willingness to repay. Because investors have no need to acquire further knowledge about the repayment capacity of highly-rated debtors, let alone any need to pay for such information, the ownership structure is a function of liquidity and yield concerns. But in lower-credit assets, I argue that this

[1] Understudied in comparison to how political actors can affect regulation or how government policy affects financial markets.

[2] In the 1990s, political strategist James Carville said "I used to think that if there was reincarnation, I wanted to come back as the president or the pope or as a .400 baseball hitter. But now I would like to come back as the bond market. You can intimidate everybody" (McCormick and Kruger, 2009).

[3] Italian price at time of writing 100.464 EUR, Portuguese price 100.433 EUR. Both have credit rating BBB+. The Italian bond has HHI 0.0005 with 6.66% of holdings reported; the Portuguese bond has HHI 0.0002 with 3.87% of holdings reported.

variation in market power exists because firms with higher risk thresholds are more willing to invest in costly information about the debtor government's ability and willingness to repay its debt.

Risk-accepting firms that pay the cost to get further information eliminate uncertainty about debtor (un-)willingness and (in-)ability to repay debt. As a result, they invest in (short) long positions in the security, buying up the positions of those investors fleeing their position because of relative risk intolerance. Such a movement results in increased market power for those risky firms that have larger positions.

I hypothesize that investors with higher risk acceptances will accrue larger positions because they are more willing to pay for information about debtor ability/willingness to repay, but only in riskier securities where debtor repayment capacity is in question. This will lead to those securities having higher ownership concentration. To take advantage of the EU's MiFID II regulations passed in 2017 that drastically changed the way financial market participants access information, I test my hypothesis in Europe from 2013 to the present. Sourcing investor-level risk appetite and ownership data from commercial financial data platforms, I use time-series empirical models to assess the effect of an investor's risk-acceptance on their position in a given security and on the security's ownership concentration.

This paper contributes a clear theoretical discussion of the causes of market power in government bond markets. This dynamic is important to political actors because it is linked to government fiscal outcomes through debt restructurings and bond market pressure. Moreover, this theoretical model contributes a conception of "ownership structure risk" as a kind of financial risk, that is unsystematic across issuers. Investors could identify such ownership structure risk as a diversifiable risk specific to one debt issuer, not a structural risk across a financial system (Melicher and Norton, 2013: Ch. 12).

The next section discusses existing literature that helps form the analytical basis for my theoretical framework, which the third section explains in more detail. The fourth section discusses research design, the fifth examines results, and the final section concludes.

2 Background

2.1 Financial Markets Affect Policy

Why the bond market? Modern countries rely heavily on bond markets for funding from creditors that are institutional investors, individuals, central banks, sovereign wealth funds, international financial institutions, and others. Naturally, these investors have different budget constraints and investment objectives. Creditors exert bargaining power over governments, sometimes with substantial policy effects: the extreme version of this phenomenon is creditor bargaining power over a government after a default. The hold-out investors referred to above used their market power to restrict Argentina's ability to pay other creditors who had agreed to a debt restructuring before repaying them the original, un-restructured debt. One of the creditors' conditions to resolving the Argentinian standoff was input in future Argentinian domestic market fund-raising (Stevenson, 2016).

The political economy literature helps illustrate the importance of the relationship between financial markets and government policy. This literature has a strong tradition of examining the relationship between capital and governments (Przeworski and Wallerstein, 1988), and more recently the connection between financial markets and governments. But most of the recent literature focuses on only one of the two possible causal directions: the effect of various political phenomena on financial assets (Ferrara and Sattler, 2018). Political phenomena affect financial assets' price level (Roberts, 1990; Campello, 2015) and volatility (Bechtel, 2009), as well as the currency composition (Ballard-Rosa et al., 2021) and maturity structure (McDade et al., 2021) of debt issuances, among other things. However, as Ferrara and Sattler (2018: p. 21) note, the connection between politics and financial markets is bi-directional: financial markets also affect the government. This should be particularly true for markets for government debt.

Three main bodies of work provide specific insight into the effects of market power in government debt markets. The first argues that the increasing concentration of the global financial system contributes to countries' unwillingness to default on sovereign debt (Roos, 2019). Because states can only really finance themselves via state-owned enterprises, taxation, or borrowing (O'Connor, 1979), such concentration imposes market discipline on debtor states by eliminating alternative financing options for countries in distress (Roos, 2019: p. 71). While Roos' analysis is insightful, it does not draw data on the ownership of particular securities, leaving room for interrogation of the mechanisms.

The second body of work digs deeper into the policy effects of bond market dependency. Kaplan (2013) offers a collective action explanation for how bond market indebtedness constrains fiscal policy. When faced with a fiscal situation that does not prioritize debt repayment, the small cost of market exit incentivizes bondholders to do so. Such market exit then "yield[s] a higher-risk premium quickly that translates into rising funding costs for sovereign borrowers" (Kaplan, 2013: p. 10). In this line of reasoning, countries with high bond market exposure are more susceptible to creditor influence and tend to have more orthodox fiscal policy as a result. Moreover, in a follow-up paper, Kaplan and Thomsson (2017) show that countries whose external debt is heavier on bonds exhibit greater fiscal balance. The authors conclude that because the "bond market" prefers governments to retain orthodox fiscal policy to better pay off debt, countries with more bond debt conform their fiscal policy to the position bondholders most prefer. But this work's dependence on aggregated data does not permit examination of the proposed mechanism, price pressure.

The third subset of the literature examines this mechanism more directly. Financial markets can apply pressure on governments to achieve influence via mechanisms such as secondary market yields reflecting requested risk premia and Keynesian "animal spirits" effects (Akerlof and Shiller, 2009; Theofilakou and Stournaras, 2012: p. 130). In Europe in particular, economics literature provides evidence that secondary bond market prices pressure governments in the European Monetary Union that enact undesirable fiscal policies by pushing up the medium-term cost of borrowing. High bond spreads push European governments to improve fiscal balances (Theofilakou and Stournaras, 2012), influence government tax policy (Lierse and Seelkopf, 2016) and discipline fiscal policy by counteracting political deadlock (Leibrecht and Scharler, 2021).

2.2 Market Power and Determinants of Ownership Structures

Individual investors have some influence over secondary market price pressure. Holders with large positions can influence asset price by strategically selling holdings, pushing up the issuing government's cost of borrowing over the long term. Alternatively, investors with large positions also have a legal avenue to pressure governments over policy: more market power makes it easier for debtholders to meet the thresholds included in the Collective Action Clauses (CACs) of government debt securities and therefore to negotiate favorable terms in debt restructuring deals. Either form of market power can contribute to financial market influence over government policy.

But why do certain investors accrue large positions that give them more market power in the first place? The political economy literature provides some clues to the causes of this (Roos, 2019), but many of the relevant analyses suffer from a high level of analysis that makes thorough interrogation of the theoretical mechanisms difficult. Fortunately, the finance literature helps fill in some of these gaps.

For the bond market to function, investors must buy and sell bonds. Rational investors make these decisions based on their expected risk-adjusted rate of return. Two sets of preferences inform an investor's calculation about default risk and therefore about risk-adjusted return. The first, policy preference, is an ideal point on the policy spectrum of the government's ability to repay. The second, risk preference, is tolerance over deviation from that ideal point. For movement in the market to occur, there must exist some heterogeneity among bond market investors across policy or risk preferences such that different investors buy and sell debt under the same conditions (i.e. there is a buyer and a seller for every transaction).

Nevertheless, traditional capital market models such as the Capital Assets Pricing Model (CAPM) and Black-Scholes assume homogeneous investor preferences. Some authors argue that assuming homogeneous preferences in these models does not accurately reflect the dynamics of equity markets and instead results in predictable and repeatable market cycles (Levy and Levy, 1996; Chan and Kogan, 2002; Abbot, 2017).

If investor preferences were homogeneous, markets should exhibit certain tendencies. Mosley (2000: p. 746) theorizes that when preferences are homogeneous, the policy consequences of investor behavior in the issuing country will be greater. Mosley finds that institutional investors broadly use the same indicators to inform their decisions, namely inflation and fiscal balance. Therefore, if preferences were homogeneous and investors use the same information to inform decisions, markets should clearly react to microeconomic policy announcements. But Mosley et al. (2020) show that prices of sovereign debt in bond markets do not systematically react to significant changes in microeconomic policy, implying that there is no entity called "the market" that reacts systematically, as a whole, to microeconomic policy changes. In fact, Brooks et al. (2018) show that higher investor uncertainty about government willingness and ability to repay does not lead to the market agreeing upon a higher risk premium for that government's debt: instead, different actors make different decisions, leading to more volatile bond spreads.

The finance literature agrees, finding clear support for heterogeneous preferences that vary across three general categories. The first is belief about repayment, which can manifest in preferences over policy of the issuing government (Hardie, 2006; Brock and Durlauf, 2010; Mosley et al., 2020) or beliefs about the underlying economic growth rate (Cvitanić et al., 2012; Chabakauri, 2015). The second is risk preferences (Levy and Levy, 1996; Fischer et al., 1996; Campbell and Viceira, 2001; Isaenko, 2008; Condie, 2008; Weinbaum, 2009; Sarasvathy et al., 2010; Christensen et al., 2012; Cvitanić et al., 2012; Chabakauri, 2015; Hauser and Kedar-Levy, 2018), which results in some customers exiting markets before others (Hirschman, 1970: pp 33-43). The third is investment goals derived from investor position, like time horizon (Modigliani and Sutch, 1966; Wachter, 2003; Sangvinatsos and Wachter, 2005; Chan and Kogan, 2001; Isaenko, 2008; Cvitanić et al., 2012; Wellhausen, 2015) or liquidity (Hauser and Kedar-Levy, 2018; Chen et al., 2020). All three kinds of heterogeneity contribute to making markets work.

Heterogeneous investor preferences mean that different bonds have different creditors who enter and exit the market at different times for different reasons. Therefore each asset has a particular ownership structure and a particular distribution of market power across its investors. For example, much of the scholarship on the pricing effect of the ownership structure of bonds analyzes what is called the preferred habitat hypothesis: investors who prefer assets of a certain time horizon will propel movements in the prices of those assets (Modigliani and Sutch, 1966). Recent empirical work has found support for the preferred habitat hypothesis (Wachter, 2003; Greenwood and Vayanos, 2010), especially in relation to pension and insurance company demand for assets at the long end of the yield curve (Greenwood and Vissing-Jorgensen, 2018). The preferred habitat hypothesis is one example of how the heterogeneity that causes investors to enter and exit certain securities results in ownership concentration or dispersion.

2.3 Why Does Ownership Structure Vary?

But the preferred habitat hypothesis does not explain why the ownership structure would be different for two assets with similar returns, currencies, and maturity profiles. The political economy literature that helps explain the policy effects of financial market movements does not explain market power, instead often forming conclusions undergirded by assumptions about untested mechanisms and homogeneous market preferences. The finance literature provides some evidence about the causes of varying ownership structures but stops short of security-level analysis of the ownership structures that vary across otherwise similar government bonds. Although some analyses assess the ownership structure effects of ECB asset purchases (Boermans and Keshkov, 2018) and the correlates of equity ownership concentration (Wruck, 1989; Gorriz and Fumas, 1996), this question remains unanswered for general government debt markets. This phenomenon deserves another look.

3 Argument

3.1 Argument Overview

This paper seeks to explain why market power, as measured by ownership structure, varies across otherwise comparable bonds. I argue that differences in ownership structure of two otherwise similar securities derives from differences in investor decisions about investment in further knowledge about the debtor's ability and willingness to repay. Substantively, the information mechanism means that under certain conditions, for certain reasons, a certain kind of investor is willing to pay to find out more about the debtor's ability/willingness to repay and another is not. The variation in this willingness across investors causes changes in ownership structure.

A tempting explanation is that investors move into risky assets because they desire leverage over debtor governments during any restructuring negotiations. But this explanation likely has little explanatory power over the ownership structure of low-risk assets such as US Treasuries, where ownership structure is more likely driven by liquidity and yield. Anyway, moving into risky assets for leverage during restructurings is a downstream effect of information and risk appetite.

Instead, I offer a two-stage information-based explanation. In the first stage, ownership structure is driven by market fundamentals when credit is good because more information doesn't make a difference to the market's high expectation of repayment. The second stage explains the variation in low-credit ownership structure according to investor risk acceptance. As credit gets worse, defaults become more likely and information about debtor ability/willingness to repay matters more. Investors with a higher risk tolerance are more willing to pay for the information that would make them more certain about the true return.[4] When they are willing to do so, they eliminate the uncertainty in their portfolio, acquire large positions and corresponding market power, and the security's ownership structure becomes more concentrated.[5]

3.2 An Example

Consider two otherwise similar securities issued by different debtors with different ability/willingness to repay (e.g. Germany G and Portugal P), where, for an uninformed investor, the mean expected return of the German security is μ_G with variance σ_G^2 and the mean expected return of the Portuguese security is μ_P with variance σ_P^2.

Because German bunds are considered the benchmark risk-free asset in Europe and Germany's willingness and ability to repay their debt are not disputed, market estimates for the expected return of the German asset are likely low (even negative recently: low μ_G) and relatively consistent (low σ_G^2). Because of this relative certainty, I expect that investors will not bother investing in further information. Investors have no reason to believe that Germany will default on its debt.

On the other hand, Portugal's more checkered credit history provides a justification for more market uncertainty about its ability and willingness to repay its debt. Investors may expect higher values for μ_P because of a higher risk premium and for σ_P^2 because of more policy uncertainty. If an investor wants to eliminates the variance of their expected return, they can invest in further information about Portuguese default risk. Risk-accepting investors are more likely to have an appetite for such inquiry; any investor who does so eliminates the variance $\sigma_P^2 = 0$ and finds out the true return for Portuguese debt r_P^*, thereby obtaining an advantage against market peers. The investor can then increase their returns by amassing a large short or long position.

Such a mechanism means that investors that accept riskier investments and have paid for the information to eliminate their uncertainty may accrue larger positions in Portuguese debt, amassing larger market shares and contributing to overall higher ownership concentration for the Portuguese security than the German security. But importantly, the distribution of the ownership of the security depends on the appetite of the market participants for information, which in turn depends on their risk appetite. This implies that variation in ownership structure across securities is a function of who the market participants are.

[4] Or is this about the probability of default? Or are they the same?

[5] I also need to grapple with the model ramifications of the incentives for short-selling vs. holding out during a restructuring.

3.3 A Model

To get a better sense of the dynamics of this relationship, I follow Calvo and Mendoza (2000) in defining the model below. In a world with total number of countries J that each have securities that follow a i.i.d. process with mean and variance ρ, σ_j^2 (the "world fund"), a specific country i pays expected return r^* with variance σ_i^2 and is correlated with the world fund according to correlation coefficient η. For a share of their portfolio invested θ, a given investor has the following indirect utility function:

$$EU(\theta) = \mu(\theta) - \frac{\gamma}{2}\sigma(\theta)^2 - \kappa, \tag{1}$$

for $\gamma, \kappa > 0$ where γ is the coefficient of absolute risk aversion, μ and σ define the mean and standard deviation of the portfolio as functions of θ, and κ is the cost of gaining country-specific information about ability/willingness to repay.

The benefit an investor receives from investing in information about country i is given by $S \equiv EU^I - EU^U$, where EU^I is the expected utility from investing in information and EU^U is the expected utility from remaining uninformed.

$$EU^U(\theta) = \left(r - \frac{\gamma}{2}\frac{\sigma^2}{J} + \frac{(\rho - r)}{2}\frac{(J-1)}{J}\left[2 + \frac{(\rho - r)}{\gamma\sigma^2}\right]\right), \text{ and} \tag{2}$$

$$EU^I(\theta) = \int_{-\infty}^{\infty}\left[\theta^I(r^I)\rho + (1-\theta^I(r^I))r^I - \frac{\gamma}{2}\left[\frac{(\theta^I(r^I))^2}{J-1}\right]\sigma^2\right] f(r^I)dr^I - \kappa \tag{3}$$

So, for any rumor r in the interval $r_{min} < r < r_{max}$, S is given by

$$\begin{aligned} S = \left(b\rho - \frac{\gamma\sigma^2}{2}\frac{b^2}{J-1}\right)F(r^I_{min}) + \int_{r^I_{min}}^{r^I_{max}}\left[r^I + \frac{1}{2}\frac{(\rho - r^I)^2}{\gamma\sigma^2}(J-1)\right]dF(r^I) - \\ \left(a\rho - \frac{\gamma\sigma^2}{2}\frac{a^2}{J-1}\right)(1 - F(r^I_{max})) + \\ \int_{-\infty}^{r^I_{min}}(1-b)r^I dF(r^I) + \int_{r^I_{max}}^{\infty}(1+a)r^I dF(r^I) - \kappa \\ -\left(r - \frac{\gamma}{2}\frac{\sigma^2}{J} + \frac{(\rho - r)}{2}\frac{(J-1)}{J}\left[2 + \frac{(\rho - r)}{\gamma\sigma^2}\right]\right). \end{aligned} \tag{4}$$

I diverge from Calvo and Mendoza (2000) by focusing on the only investor-level characteristic affecting investment is γ, which does so in some linear combination of the other terms of the model. I calculate $\frac{\partial S}{\partial \gamma}$, which gives the incremental change in the advantage to investing in knowledge for an incremental change in investor risk appetite γ. After some simplification, $\frac{\partial S}{\partial \gamma}$ is given by

$$\begin{aligned} \frac{\partial S}{\partial \gamma} = \left[\left(-\frac{\sigma^2}{2}\right)\frac{b^2}{J-1}F(r^I_{min}) - \frac{1}{J} + \left(\frac{a^2}{J-1}\right)(1 - F(r^I_{max}))\right] - \\ \frac{1}{\gamma^2}\left[\left(\frac{(J-1)}{2\sigma^2}\right)\int_{r^I_{min}}^{r^I_{max}}\left[(\rho - r^I)^2\right]dF(r^I) + \frac{(\rho - r)^2}{J}\right]. \end{aligned} \tag{5}$$

Equation 5 shows that $\frac{\partial S}{\partial \gamma} > 0$ (riskier firms get more of a benefit to paying the cost of information κ) when the first term on the right hand side is larger than the second. In such a situation, the rate of change of S (the benefit from information) decreases in relation to $\frac{1}{\gamma^2}$.

For $\gamma > 0$,[6] $\frac{\partial S}{\partial \gamma}$ increases as γ increases.[7] But the value of γ at which an investor's incremental gain for riskier behavior becomes positive depends on the relative values of the first and second bracketed terms on the right hand side of the equation. That is, an investor can only increase their benefit of investing in information S by increasing γ if they are comfortable with a minimum level of risk given by

$$\gamma^* = \sqrt{\frac{\left(\frac{(J-1)}{2\sigma^2}\right)\int_{r^I_{min}}^{r^I_{max}}[(\rho - r^I)^2]\,dF(r^I) + \frac{(\rho-r)^2}{J}}{\left(-\frac{\sigma^2}{2}\right)\frac{b^2}{J-1}F(r^I_{min}) - \frac{1}{J} + \left(\frac{a^2}{J-1}\right)(1-F(r^I_{max}))}}. \tag{6}$$

If the first bracketed term in Equation 5 is larger than the second, Equation 6 will result in $\gamma^* < 1$. Therefore investors can experience positive changes in S by increasing market risk acceptance beyond some γ such that $\gamma^* < \gamma < 1$. If the second bracketed term is larger than the first, only more extreme values of γ such that $1 < \gamma^* < \gamma$ can experience positive changes in S. In other words, only for behavior sufficiently risky is there an incremental gain in S for riskier behavior.

3.4 Hypothesis

From this theory, I derive the hypothesis that for securities with lower credit ratings, riskier firms invest in information to find out more about the true return of and probability of default on the security. Such investment leads to these firms eliminating the variance in their expected return and accruing larger positions; securities with more risk-accepting investors will therefore have higher ownership concentration.

4 Research Design

4.1 Empirical Setting

I set my empirical adjudication in the EU from 2013 to the present for several reasons. First, although EU countries share a monetary framework, each issues its own bonds. EU countries have a variety of credit ratings deriving from the fact that each has its own fiscal policy. The monetary union under the Euro also has the advantage of removing exchange rate fluctuations as a variable. Second, data availability is quite good for EU countries. Third, in 2017 the EU promulgated the Markets in Financial Instruments Directive 2 (MiFID), which (among other things) required that financial firms selling assets (sell-side firms) can no longer include market research as a part of their sales and instead must charge separately for the research product. This had an immense effect on the structure of the financial research industry: sell-side firms consolidated or eliminated their research departments and firms allocating assets (buy-side firms) beefed up their in-house research capacity. The plausible exogeneity of MiFID is an important driver of a change in the information landscape for market players.

[6] In other words, investors whose funds do not move counter-cyclically to the market.

[7] As γ increases, $\frac{1}{\gamma^2}$ becomes smaller, and $\frac{\partial S}{\partial \gamma}$ becomes larger.

Furthermore, the EU provides plausible tests of various kinds of policy pressure that financial markets can exert. With a variety of governments, most or all in need of capital, the EU is an ideal location for bond price pressure to create influence over government policy. Secondly, the variety of credit conditions present at various times in the EU presents the possibility that governments are operating under unsustainable fiscal conditions with real possibilities for debt distress and near default, providing opportunities for more concentrated investors to make more policy demands of governments.[8]

4.2 Data Description

Assessment of this hypothesis has stringent data requirements. First, holdings data on government bonds is quite difficult to come by. Even when procured, it is limited by the reporting requirements of the relevant jurisdictions.[9] I source ownership data from the FactSet Standard Ownership Data Feed V5. This data describes each holder of a bond: who they are, how much of the security they hold, and more. FactSet sources this data from regulatory filings as well as text-based data from investor websites and portfolio descriptions. I derive the ownership concentration of the security from this data. Because investors report their holdings at different frequencies, I backfill investor holdings to cover the months in between their reports. Therefore the holdings data is at the holder-security-month level.

Secondly, because my theory relies on time-series pricing of securities, I must obtain a historical security-level pricing data. Even in high-fidelity commercial data repositories like Bloomberg, such data is spotty at best. I source historical bond pricing data from the FactSet and descriptive data on each security (e.g. coupon rate, maturity date, amount outstanding, etc.) from FactSet and Bloomberg.

I also incorporate data to account for other possible explanations of my hypothesis. For example, investor willingness to purchase or hold bonds could be directly related to a policy decision and unrelated to ownership concentration. To account for this explanation, I incorporate the Standard and Poors rating of each specific security at a given point in time. Credit ratings agencies incorporate political and economic attributes of issuers into credit ratings, so I avoid including extra variables for system of government, timing of elections, history of democracy, average time to maturity of outstanding debt. I will also account for other factors have been shown to relate to the pricing of government bonds, such as each security's maturity length, price level, spread to US Treasuries, time remaining until maturity, and coupon rate. Other higher-level cross-issuer conditions that could affect prices are captured in the security-specific credit rating.

4.3 Variable Definitions

This paper is the first time that a comprehensive data set of bond ownership has been used in political economy literature.[10] The data set started by obtaining descriptive data on all bonds held from 2013 to the present by sovereign issuers in the European Monetary Union (19 countries and 4,880 securities).

[8]Although the possibility of ECB intervention in such a situation remains real.

[9]For example, institutional investors must report their holdings periodically but hedge funds need not do so. As a result, holdings data systematically omits hedge fund holdings. Greenwood and Thesmar (2011) have a clever mathematical work-around to this problem.

[10]To the author's knowledge.

The creditworthiness of security i is given by cr_{it}. I define the risk-acceptance of a debtholder to be the market beta of the investor β_{jt}, as reported by FactSet, which measures the volatility of the fund that holds the security in comparison to the S&P 500. A value of $\beta = 1$ means the fund is as volatile as the market, values over 1 mean the fund is more volatile than the market, and values less than 1 mean the fund is less volatile. Negative values mean that the fund moves in the opposite direction as the market (e.g. gold). β values are measures of systematic risk (that is, risk that cannot be diversified out of the portfolio) and therefore suitable for measuring the general risk-acceptance of the investor.

A description of the data set immediately raises an issue with the overall lack of data. Holdings data is only available from 2013 to the present. Although holdings data is available individually for some bonds before 2013, this early holdings data is inconsistent across time, the type of bond, and often within one bond. Some of this inconsistency can be explained by the issuer calling a bond before its maturity date, which results in some bonds having reported holdings data for only a subset of their original maturity.

I measure my main dependent variable two ways. The first measure is the percentage of outstanding debt that the given holder owns. For security i in month t with total amount outstanding o_{it}, I calculate a debtholder j's percentage held p_{jit} where holder j holds a amount of the security, to be

$$p_{jit} = \frac{a_{jit}}{o_{it}}. \tag{7}$$

The second measure of the dependent variable is the Hirschman-Hirfindahl Index (HHI) of ownership concentration.[11] For security i in month t with total amount outstanding o_{it}, I calculate the ownership concentration h_{it} across all owners $j = 1, 2, \ldots n$, where holder j holds a amount of the security, to be

$$h_{it} = \sum_{j=1}^{n} \left(\frac{a_{jit}}{o_{it}} \right)^2. \tag{8}$$

Figure 1 shows that the ownership concentration of many bonds does changes over time. Notably, though, there is a cluster at one unique HHI per security. Several factors likely contribute to this phenomenon. Bond investors can hold a position over a long period of time because they seek conservative long-term returns or because they are passive investors (Sangvinatsos and Wachter, 2005; Sushko and Turner, 2018). Moreover, only some holders are required to report, so those that do report can often be institutions who hold stable positions. This pattern is clear in Figure 2, which shows the percentage of outstanding debt accounted for in the data at a security-month level. Lastly, bond investors often do not pay careful attention to the contract terms of their bonds and their positions may remain constant as a result (Kahan and Klausner, 1997; Gulati and Scott, 2012; Gulati and Kahan, 2018; Kahan and Gulati, 2021). Nonetheless, there is enough variation in h_{it} to permit valid analysis.

Some securities in particular have both a long time-series of available data and a variation in h_{it}. Figure 3 shows h_{it} plotted over time alongside the price for CUSIP $13063A5G5$.

[11] In line with (Cetorelli et al., 2007; Peltonen et al., 2014; Boermans, 2015), among others.

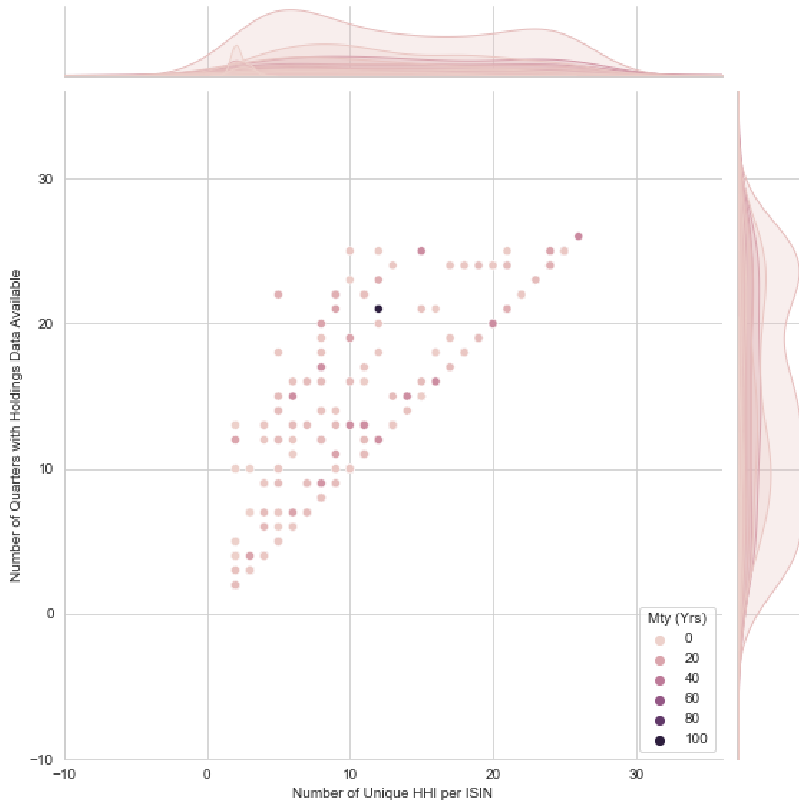

Figure 1: Data availability for securities with holdings data. Note that most securities have less than ten quarters data available and less than five unique values for h_{it}.

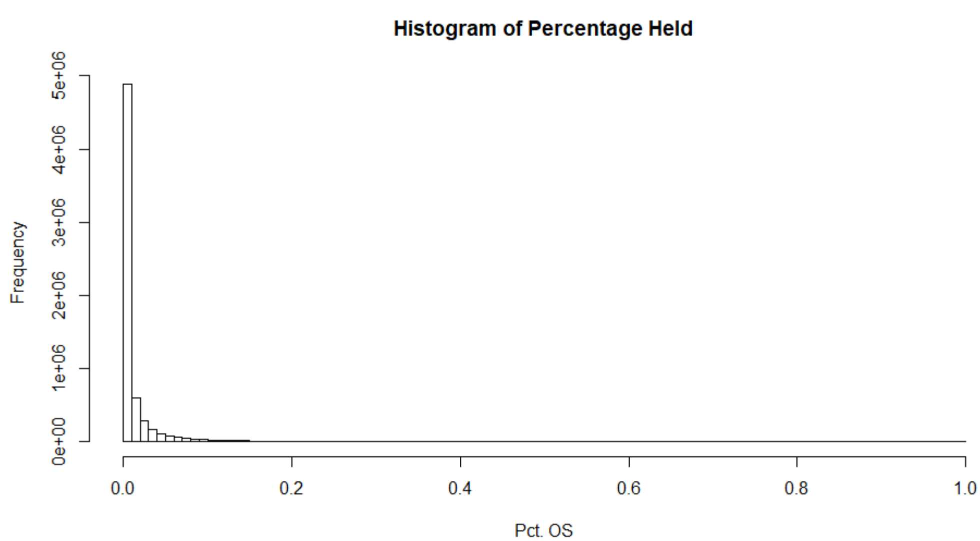

Figure 2: The distribution of the known percentage outstanding at the security-quarter level.

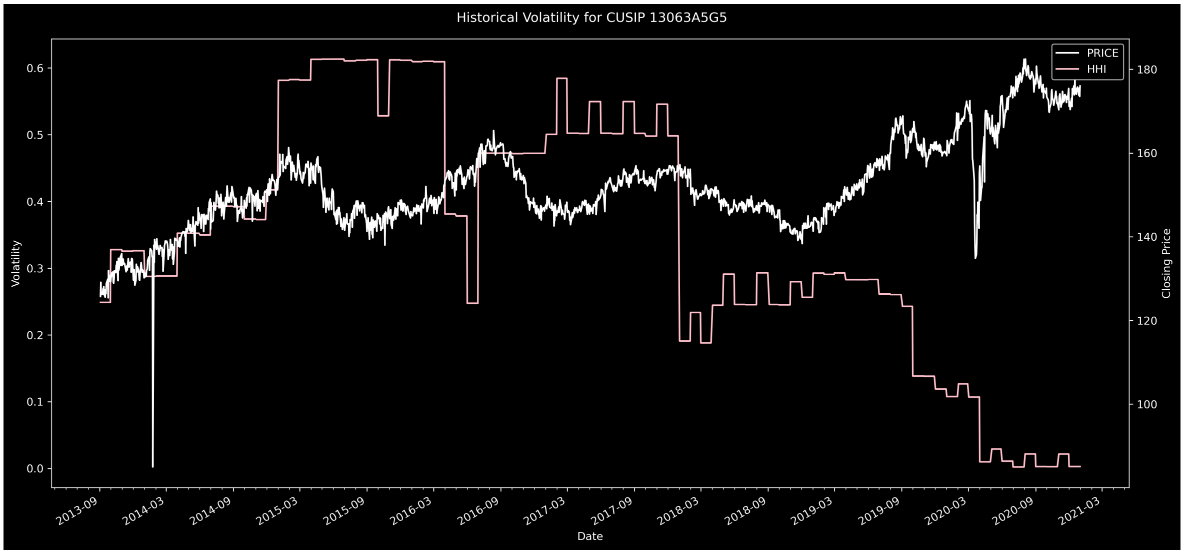

Figure 3: The price and ownership concentration for a particular security over time.

5 Empirical Models and Results

I take a two-part empirical approach to test my hypothesis, using time-series models to regress investor risk acceptance interacted with security credit rating on ownership structure. I first test the basic relationship with a linear model. I then move on to testing the inverse quadratic relationship suggested by the formal model.

5.1 Analysis and Results: Percentage Held

Figure 1 shows that an investor's position in a security is likely time-dependent: an investor is more likely to have an investment if they had the investment during the prior reporting period than if they didn't. To account for this possibility, I use an empirical model that accounts for within-security time dependency. Because the dependent variables p_{jit} and h_{it} are highly skewed, I take their logarithm.

Further estimation difficulties could arise from the varying reporting cadences of the data points: in the present incarnation of the data set, each investor's reported β value is a point-in-time estimation rather than a historical time-series. I hope to fix this in a future version of the paper. I estimate the following equations:

$$\log(p_{jit}) = \alpha_{jit} + \tau_{jit}\beta_{jit} * cr_{it} + \upsilon_{jit}\beta_{jit} + \psi_{jit}cr_{it} + \omega_{it}Z_{it} + \mu_j + \mu_i + \mu_t + \varepsilon_{jit}, \tag{9}$$

My hypothesis would find support from a negative value of τ_{jit} and positive value of υ_{jit}, which would imply that higher levels of p_{jit} and h_{it} are associated with higher risk acceptance for riskier securities.

I also assess the quadratic relationship suggested by Equation 5. I construct a new variable $b_{jit} = 1/\beta_{jit}^2$ and include its interaction with cr_{it}. Because b_{jit} ends up being very small, I normalize it on a scale of zero to one. I then estimate the following equations:

$$\log(p_{jit}) = \alpha_{jit} + \tau_{jit} b_{jit} * cr_{it} + \upsilon_{jit} b_{jit} + \psi_{jit} cr_{it} + \omega_{it} Z_{it} + \mu_j + \mu_i + \mu_t + \varepsilon_{jit}, \quad (10)$$

Because Equation 5 shows an inverse relationship between γ and b, my hypothesis would find support from coefficients with the opposite signs of the first time-series regression. That is, positive values of τ_{jit} and negative values of υ_{jit} would imply that more risk-accepting investors accrue larger positions in riskier securities.

Table 1: Linear Time-Series Results

	Dependent variable:	
	$\log(p_{jit})$	
	(1)	(2)
β	0.0031***	
	(0.0001)	
b		−0.0323***
		(0.0009)
cr	−0.0269***	−0.0272***
	(0.0001)	(0.0001)
Amt. Outstanding	−0.0000***	−0.0000***
	(0.0000)	(0.0000)
Yield	0.0082***	0.0062***
	(0.0012)	(0.0012)
Pct. OS Known	0.0286***	0.0285***
	(0.0002)	(0.0002)
Spread to US Treasuries	0.0002***	0.0003***
	(0.0001)	(0.0001)
Months to Maturity	615.8970***	611.6504***
	(2.4680)	(2.4662)
Months to Maturity Squared	199.2312***	206.9558***
	(2.2033)	(2.1667)
$\beta * cr$	−0.0001***	
	(0.00001)	
$b * cr$		−0.0029***
		(0.0001)
Constant	−4.7482***	−4.7427***
	(0.1375)	(0.1370)
Observations	6,685,765	6,685,765
Log Likelihood	−14,154,669.0000	−14,154,129.0000
Akaike Inf. Crit.	28,309,366.0000	28,308,285.0000
Bayesian Inf. Crit.	28,309,558.0000	28,308,477.0000
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 1 shows the results of the time-series model with monthly fixed effects: the first specification shows the results of the linear interaction and the second specification shows the results of the quadratic specification derived from the formal model.

The linear results show that β is positively and statistically significantly associated with $log(p_{jit})$. However, because the models are set up to measure interaction effects, the results must be interpreted carefully. Substantively, the coefficient for β means that when rating is measured to be zero (not possible in practice) an increase in investor risk-acceptance corresponds to, on average across all bonds and investors, a 0.0031% increase in the log percent of outstanding debt held, providing baseline support for the hypothesis.

But in reality, the rating variable never takes the value zero (it takes the values 1 to 23, corresponding to credit ratings of ”Not Rated” to ”AAA”, respectively), so any substantive interpretation of these coefficients must depend on the standalone coefficient in conjunction with the interaction coefficient. When the rating variable increases by one (that is, credit quality gets better by one level), the total effect of β on $\log(p_{jit})$ decreases by 0.0001. Because the magnitude of the interaction coefficient is far less than the magnitude of the baseline coefficient for β, a one-level increase in bond rating corresponds to a drop in the investor's willingness to hold such a security, but retains the positive overall effect of β on $\log(p_{jit})$. The results support the hypothesis both in sign and magnitude.

The second specification shows the results of the quadratic regression. The estimated coefficient for the effect of b on $\log(p_{jit})$ is indeed negative and significant, and the coefficient of the interaction term is positive and significant. Substantively, these results mean that when the rating is zero (not possible), a one standard deviation increase in an investor's b corresponds to a 0.0323 decrease in the investor's logged percent held of outstanding debt. The interaction term has the opposite sign that my hypothesis predicts.

NOTE:

I need to revisit sign expectations for these terms.

Besides investor risk acceptance, other variables hold statistically significant relationships with ownership structure. The effect of the remaining amount of time until maturity follows a quadratic path: the effect on $\log(p_{jit})$ increases for every day closer a bond comes to maturity, at an increasing rate. This makes substantive sense: investor risk aversion plays a bigger role in determining holdings closer to a bond's issuance and the further away from its maturity. This could be because uncertainty decreases as maturity approaches, and investor risk aversion measures comfort with uncertainty.

Bonds with higher spreads to US Treasuries (riskier bonds) take up slightly higher percentages of investor portfolios than safer ones do on average, and bonds with higher yields also have higher average holdings.

5.2 Analysis and Results: HHI

Still to come.

6 Conclusion

In conclusion, I find some evidence suggesting that investors are more likely to amass larger positions in government debt securities when riskier firms invest in information to find out more about the true return and probability of default on the security. These larger positions amassed by riskier investors contribute to differences in ownership structure between otherwise similar bonds. Ownership structure is nothing if not a measure of the market power held by individual creditors in government debt markets, which has been shown to hold serious policy influence over governments.

In this paper, I clarify the fundamental relationship between risk appetite, information flows, and ownership structure. Testing my hypotheses on European sovereign bonds, I find some evidence suggesting that an investor is likely to have a larger position in a security if it has a higher risk appetite and the security issuer has worse credit. This effect likely occurs because risk-accepting investors invest in information that eliminates the variance of their expected return for lower-credit securities. The effect is less prominent in higher-credit securities because investors have less reason to doubt debtor ability and willingness to repay, making investing in further information unnecessary.

However, the present form of the empirical methods I use to adjudicate my hypothesis has its drawbacks. Because of data availability constraints, the time-series analysis relies on only data that is available: unfortunately, pricing and ratings data for expired sovereign debt is not easy to come by. In addition, the measurements of investor β are only snapshots of a moment in time rather than historical time-series, which is less than ideal. However, taken as a whole, the weight of the evidence suggests that riskier investors and lower-credit securities have higher ownership concentration.

Possible future work includes examining different aspects of the ownership structure of government debt. Different kinds of debt holders have different goals, which likely means that they have divergent policy tolerances. A deeper understanding of these concepts could arise from similar investigations.

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