Do Banks Care about the Environment? Estimating the Greenium and Implications for Bank Lending

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ABSTRACT

In this paper I study the role of banks in financing the transition to a cleaner economy. I find that as firms become more ESG-focused they increase their use of bond financing relative to bank borrowing. I match newly originated loans to existing bonds to show that the loan-bond spread increases in the ESG score of the firm, supporting a cost of capital discount channel. The information insensitivity of bank deposits rationalizes the main result, as stronger ESG preferences are passed through to a lower cost of capital for bonds relative to loans. Using the ESG premium implied by bond markets as a benchmark, I study the implications for lending volumes if policymakers force banks to internalize non-pecuniary green preferences.

JEL Classification Codes: G21, G32, Q50

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I. Introduction

'Green' assets have grown substantially over the last decade. Nearly 90 percent of the clients of the world's largest asset manager, BlackRock, rank the environment as the top priority among ESG considerations. Simultaneous to the rise of public market investor preference for green companies, the CEOs of banks have begun to increasingly emphasize their commitment to sustainable lending practices.[1] However, concerns remain that banks continue to finance dirty corporations. For instance, a leading environmental group, the Rainforest Action Alliance, indicates that large banks provided 4.6 trillion USD in financing toward fossil fuel emitting companies between the installment of the Paris Agreement in 2016 and 2021.[2] In this paper, I study the role of banks as a financing source as firms decide on their ESG policy. I find that firms decrease their reliance on bank loans and increase their relative usage of bond financing as they increase their ESG score. The increase is driven by an increase in bond usage and a mild substitution out of bank loans.

Firms' preference for bonds as they move up the ESG stack arises from a cost of capital discount on bonds relative to bank loans. Bond markets effectively internalize the non-pecuniary utility of the representative investor with respect to ESG, while banks are insensitive to the ESG quality of the firm. The result highlights an important tension in climate policy: if existing mechanisms result in a scenario where banks simply fill in for capital markets in financing dirty companies, then policymakers may want to consider alternative mechanisms to incentivize banks to finance the transition to a more green economy. However, these policy proposals may be socially inefficient as they may constrain bank lending volumes or they may encourage excessive risk-taking. I present a simple

[1] For example, JP Morgan wrote in their 2021 ESG report that they provided $285 billion USD to sustainable businesses in 2021.

[2] https://www.ran.org/wp-content/uploads/2021/03/Banking-on-Climate-Chaos-2021.pdf

framework for studying the welfare implications of policy intervention to incentivize more ESG-sensitive bank lending practices.

The finding that higher ESG firms use fewer banks loans is not obvious. Why might banks be more inclined to lend to green firms? First, banks make use of loan covenants and relationship lending to encourage firms to transition away from 'dirty' business practices. For instance, a recent paper (Houston and Shan (2021)) finds that banking relationships promote increases in ESG scores by showing that banks are more likely grant a loan to borrowers with similar ESG scores. Second, banks have incentives to go green due to the threat of regulatory oversight and potential climate-based capital charges. For instance, the Federal Reserve has been increasingly vocal in recent years about their interest in potentially incorporating climate considerations into stress testing exercises. [3]

On the other hand, why might banks be less likely to finance greener firms? The primary reason is that higher ESG firms may be less risky, and thus have less need for bank relationship stability in times of crisis (Bolton and Freixas (2000)). To rule out risk as the driving force, I will include a measure that controls for changes in credit risk. I compare loans and bonds in the same period to study whether ESG scores increase the interest rate wedge between the two instruments. I hypothesize that this arises from the fact that the non-financial preferences of the representative investor may be transformed into the relevant pricing kernel only for bonds. Due to the information insensitivity of bank deposits (Dang et al. (2017)), that same transformation does not occur for bank lending. For this mechanism to be at play, we must also assume that the bank manager is less ESG sensitive than the representative investor. This is likely to be the case, as bank managers are more likely to be sensitive to the short term profit demands of their shareholders. It could also be the case that the marginal holder of bank deposits is simply less sensitive to

[3] A Reuters article written in Nov. 2021: "Wall Street sees first Fed climate change review in 2023". https://www.reuters.com/business/cop/wall-street-sees-first-fed-climate-change-review-2023-2021-11-17/

the ESG qualities of their asset holdings when compared to the marginal holder of bonds. This market segmentation could give rise to two separate pricing kernels for each type of debt capital. I address this alternative explanation by drawing on data from the Survey of Consumer Finances.

With these potential mechanisms in mind, I show that as firms move up the ESG score spectrum they obtain an increasingly smaller share of their debt financing from banks. I add firm, year and credit rating fixed effects and time varying controls to rule out a simple size-based or risk-based narrative. I employ an instrumental variable specification similar to Berg et al. (2021a) to de-noise the potentially substantial ESG measurement error at the firm level. More specifically, I use the ESG score of the firm's competitors as the driver of the firm's own ESG score changes. I construct a sample of newly issued syndicated loans from Dealscan and match them to the yields of outstanding bonds. I proceed to show that the loan-bond yield spread of the matched sample increases in the ESG score of the firm, controlling for the characteristics of the loans, bonds, and issuer. To further unpack the incentives of banks to lend to higher ESG firms, I study the sensitivity of depositors to the ESG scores in the cross section of US banks. I find evidence in support of the hypothesis that deposit flows are insensitive to the ESG score of banks. Finally, I present I simple framework for studying the efficacy of policy intervention to force banks to internalize non-pecuniary ESG sensitivity, using the loan-bond spread to estimate a benchmark greenium.

Related literature: The paper relates to a few strands of literature. First the paper relates to the classical debt capital structure literature. In a frictionless market, firms' capital structure decisions are irrelevant (Modigliani and Miller (1958)). While departures from the frictionless framework are numerous, I focus in particular on the firm's decision to borrow from public markets or banks. In a seminal paper, Petersen

and Rajan (1994) studies relationship lending to indicate that bank-firm relationships increase credit access. Bolton and Freixas (2000) shows that while firms often turn to banks in times of financial distress, this flexibility is costly, so riskier firms prefer bank loans while safe firms tap bond markets in equilibrium. Similarly, Faulkender and Petersen (2006) studies the leverage decisions of firms with access to public markets, finding that access to bond markets increases leverage. De Fiore and Uhlig (2011) estimate a dynamic general equilibrium model where firms choose their debt capital structure, emphasizing the ability of banks to resolve informational problems. More recently, Crouzet (2017) studies credit disintermediation and in particular emphasizes that increased bond intermediation (versus bank lending) caused a larger decline in real investment during the Global Financial Crisis in 2008. Darmouni and Siani (2020) studies firms' usage of bond markets as a tool for liquidity management during the COVID crisis in a way that has historically been associated with bank lending relationships. In this paper I study whether there is a differential propensity of firms along the green spectrum to borrow from public debt markets or banks.

The second relevant strand of literature includes analysis of ESG considerations and the existence of a greenium in capital markets. As an adjacent but foundational paper, Hong and Kacperczyk (2009) finds that 'sin' companies outperform other companies due to disutility penalties imposed by investors that take the shape of higher costs of capital. In the context of environmental concerns in particular, the residual influence of ESG in asset pricing has garnered significant interest in recent years (Hong et al. (2020)). Bolton and Kacperczyk (2021) studies capital market pricing of climate transition risk. Baker et al. (2018) studies the pricing and ownership of green bonds, finding that green bonds are issued at a premium of several basis points. Similarly, Flammer (2021) finds that the issuance of green bonds credibly signals a commitment to improve ESG scores going forward. In a cross country analysis, De Haas and Popov (2019) finds that stock markets

encourage more green investment relative to debt financing. Starks et al. (2017) finds that long horizon investors tend to prefer higher ESG stocks. Pastor et al. (2022) studies the greenium by comparing green bonds to conventional bonds and argues that green stocks outperformed due to strong increases in green preferences rather than higher expected returns. In this paper I add to the literature by studying the within debt capital structure substitution margin between bonds and loans. Arguably this is more important for firm decision making as debt is usually the marginal source of financing rather than equity, and most large important firms have access to both bond and bank loan markets.

The third relevant strand of literature includes bank lending and climate considerations. Zhang (2021) finds that climate risk is priced into syndicated loans, whereby dirtier firms pay higher interest rates. Ivanov et al. (2020) finds that carbon pricing mechanisms cause higher emission firms to experience lower quality access to bank credit, in the form of shorter maturities and higher interest rates. Reghezza et al. (2021) finds that climate-oriented regulatory policies cause banks to shift credit away from polluting firms, supporting the idea that green policy initiatives can have an impact in reducing emissions. Kacperczyk and Peydró (2021) studies the interaction between emissions and bank lending, finding that banks reallocate credit from high emissions firms to low emissions firms due to green considerations, and not due to risk considerations. Degryse et al. (2020) studies the incentives of banks to lend to green firms while balancing costs to their existing 'brown' portfolio, emphasizing the importance of legacy credit in any regulatory policies. The most similar paper is Houston and Shan (2021), which shows that banks are more likely to match with firms with similar ESG profiles, and that this ESG-closeness improves the ESG qualities of the borrowing firm. In contrast to the previous studies, I study bank lending in general (not just for closely matched bank-firm pairs), and I focus on firms' substitution margin between capital sources. This is arguably more important when we consider the incentives of firms to adopt costly ESG measures.

The paper relates to literature that studies deposits as a safe and information insensitive asset from the perspective of the depositor. In particular, Dang et al. (2017) emphasizes the incentives of financial intermediaries to maintain private information regarding their assets, in order to maintain the information insensitivity of their safe debt claims. I extend the theory of information insensitivity of deposits to the ESG setting.

Lastly, the paper relates to voluminous literature that studies bank capital requirements (e.g. Corbae and D'Erasmo (2021), Begenau and Landvoigt (2021)). While the usual bank capital requirements are implemented to curtail the moral hazard induced excessive risk taking by banks, the regulation I consider attempts to affect the ESG-insensitive lending of banks. A recent theoretical paper Oehmke and Opp (2022) studies green capital requirements with the goal of distinguishing the implications of brown penalizing or green supporting capital requirements. The regulation involves a trade-off between distorting the bank's original optimization problem with the social costs associated with 'dirty' lending. The authors ultimately conclude that capital regulation is a relatively blunt tool to address carbon externalities. In this paper I provide an empirical approximation of the implications of instituting green capital requirements for actual lending volumes.

Section II presents the baseline predictions to be tested. Section III reviews the data and provides stylized facts. Section IV presents reduced form evidence and the cost of capital channel. Section V presents an illustrative model of firm capital structure decisions in the presence of ESG considerations and costly ESG adjustment costs and presents a simple example of the implications for credit flows. Section VI concludes.

II. Hypothesis Development

In this section I present the baseline hypothesis that relates the ESG policies of a firm to their capital structure decisions. In a frictionless MM world, the source of financing would be irrelevant.

In summary, I postulate that the primary factor that drives banks to provide financing to dirty companies as public markets pull away relates to the particular nature of bank deposits relative to other savings vehicles available to households. More specifically, consider a household that gains positive (negative) utility from financing a 'green' (dirty) company and chooses to allocate their savings in either bonds or bank deposits. When a household places their money in a bank deposit, they do so primarily to benefit from the near-money qualities of the deposit and are made 'sleepy' by deposit insurance. In contrast to bank deposits, bonds are assets that derive their value from the underlying characteristics of the issue. That is to say, the price of the bond results from the cash flow, default probability, and ESG characteristics of the borrowing firm while the price of the bank deposit depends only on the deposit rate and its money-like properties. Accordingly, when a bank provides a loan to a dirty company, the disutility generated by financing the dirty firm does not correspond to an increased deposit rate demanded from the saver. Motivated by the difference between deposits and bonds, the first hypothesis to test considers the relative margin of debt usage.

H1: Increases in the ESG score of a firm are associated with increases in their bond usage relative to their loan usage. This effect should hold while controlling for credit risk, as it operates through a preference channel, rather than a simple risk story.

The observed effect could be due to the fact that, upon experiencing an upgrade in their ESG quality, firms simply increase their bond usage while leaving their loan usage

undisturbed. For instance, consider a firm that operates a constant returns to scale technology that is shock with a positive ESG increase. The bank's pricing decision may be insensitive to the ESG score of the firm, while bond markets may gain additional utility from financing the greener firm, leading to a cost of capital subsidy. In this case, the firm would simply scale up their bond financing usage while leaving their loan borrowing unchanged. Alternatively, if the firm operates a decreasing returns to scale technology, the firm may substitute out of loans and into bonds, while keeping their aggregate borrowing approximately unchanged. This leads to the second hypothesis:

H2: Increases in the ESG score of a firm lead that firm to increase their bond usage, while only mildly decreasing their bank loan usage.

Hypothesis 2 is based on the idea that the primary channel is one of bond subsidies, rather than explicit sin investing on the part of banks. That is to say, the bank does not actively gain non-pecuniary utility from investing in dirty firms. Rather, any substitution effects are due to partial capital structure substitution as loans are relatively more attractive on the margin for a dirtier firm.

There is a potential challenge to the previous hypothesis regarding segmented ESG preferences. If the marginal shareholder of bank equity is the same as the marginal investor in corporate debt, then in principle the bank equity shareholder may exercise control over the lending practices of the bank and thus force the bank to internalize the ESG preferences in the same way. However, as long as there are informational frictions in the corporate governance mechanism or partial segmentation between ESG preferences across firms, then the insensitivity of deposits can drive the observed result. This is an important consideration that I leave to future work for a more direct treatment.

III. Data and Stylized Facts

A. Data sources

In this paper I draw from several data sources. I start with an annual panel of CRSP-Compustat matched firms beginning in 2011. I choose 2011 as the starting year primarily due to the observation that the quality and the quantity of ESG ratings increased in recent years. I drop observations in the financial and public administration sectors and observations with non-positive total assets and firms with negative book equity. I follow Crouzet (2017) to construct a measure of bank loan reliance using Compustat inputs.

Next, I use data on the ESG ratings of firms. There is a wide debate on the 'correct' ESG ratings. For instance, recent literature has found substantially weaker-than-expected correlations between many of the widely cited (Berg et al. (2022)). For my purposes, as long as investors use *some* ESG ratings in their decision making process, the degree to which ESG ratings perfectly match actual green outcomes is secondary. Furthermore, imperfections in ESG measurement generally provide a higher bar for statistical measurement as long as the measures are not contaminated with extraneous measures of financial performance. With those caveats in mind, I primarily use ESG scores from Refinitiv. I complement my Refinitiv results with separate ESG data pulled from Bloomberg. The number of firms with ESG scores increases throughout the sample. In Table 1, I show summary statistics for the final sample. We observe that the ESG score coverage increased substantially over the sample period. There were around 260 matched observations in 2011 to over 1000 in 2021. Next we notice that the log average total revenue decreased substantially throughout the sample due to the increased coverage of smaller firms. Concurrently we note an increase in the average bank share due to more smaller firms being included in the sample.

Table 1 Summary Statistics

Year	N(Firms)	Av(Revenue)	Av(Bank Debt Share)
2010	257	15.12	25.23
2011	269	17.36	28.59
2012	277	16.66	28.31
2013	288	16.85	27.14
2014	297	17.07	28.96
2015	402	11.73	35.59
2016	561	8.90	39.82
2017	769	7.68	43.29
2018	914	7.15	44.45
2019	1197	5.61	53.84
2020	1336	5.03	53.67
2021	1121	6.73	50.82

In the first results I redistribute the ESG percentiles into five quantiles. I label the resulting measure as the ESG Bucket of the observation in subsequent tables, with a higher ESG bucket corresponding to a higher ESG score.

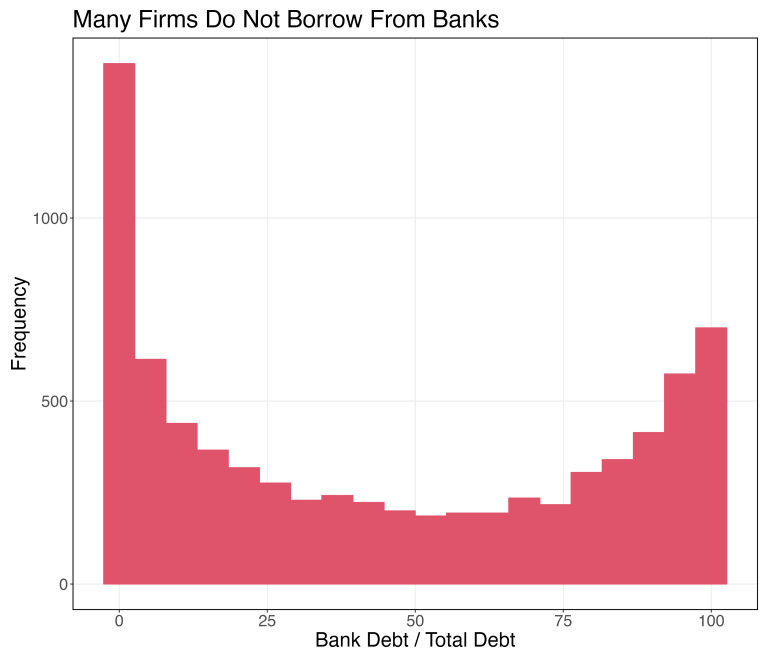
In later analysis, I expand the analysis into security level data to analyze how ESG scores affect the pricing of different instruments. I download bond level issuance and ratings data from Mergent FISD to study how ESG considerations are transformed into primary yields. In addition to the primary issuance data, I also download the WRDS Bond Returns dataset, which aggregates data from TRACE to the bond-month level. The Bond Returns dataset provides a view on how ESG considerations affect secondary market yields. Moving to the bank lending data, I download syndicated loan data from Dealscan. I use the sample code provided by Berg et al. (2021b) to construct a loan-level data set from Dealscan. I merge the Dealscan loan facilities using the updated Dealscan-Compsutat matcher from Chava and Roberts (2008). I supplement the Chava-Roberts matcher with the NLP-based matching algorithm from Cohen et al. (2021) to update the match through

end-2020. I winsorize the main variables for the security level dataset at the 5% level to reduce the influence of outliers.

B. Bank Debt Shares across ESG Scores

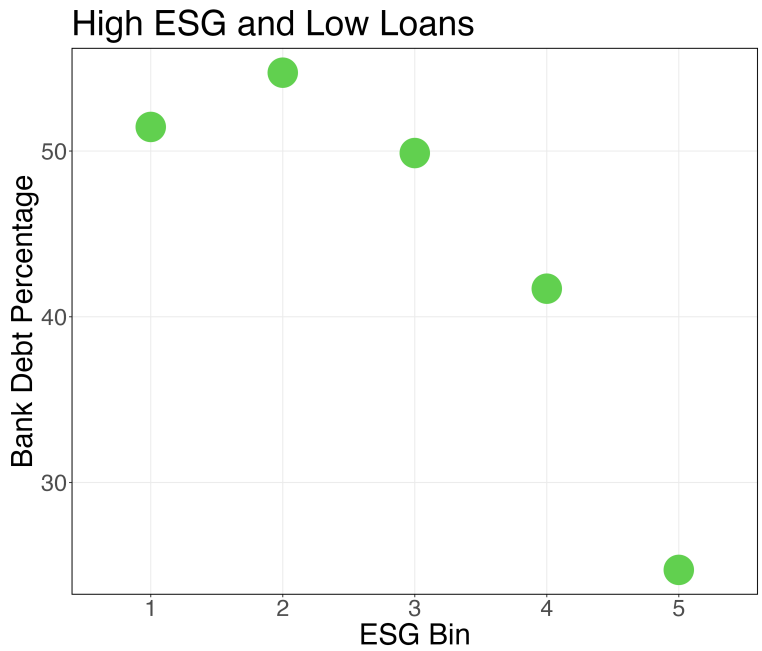
In this subsection I show stylized facts regarding the prevalence of bank financing for firms in my sample. The first observation is that many firms do not use bank financing at all. In Figure 1, I show the distribution of bank loan reliance for firms in the sample. We observe a U-shaped distribution where many firms use little to no bank financing while other firms borrow almost entirely from banks.

Figure 1. Distribution of Bank Debt Share



In Figure 2, I split the sample into five ESG score buckets, and I find the average share of bank debt within each bucket. On the x-axis is the ESG Bucket and on the y-axis is the bank debt share of total debt as measured by Compustat.

Figure 2. ESG and Loan Reliance



We observe that there is a strong decrease in the bank debt share as we move up the ESG score spectrum. The natural response to the figure is that there are many other factors that may be correlated with ESG scores which also determine a firm's propensity to borrow from a bank. For instance, it is also the case that average firm size decreases and average traditional credit quality increase as we move up the ESG spectrum. The size effect follows from the literature Petersen and Rajan (1994) that banks specialize in financing smaller, harder to evaluate firms. Before proceeding to a more rigorous treatment of the relevant control, I show the same result using the alternative Robeco ESG measure in Figure 5 in the Appendix, which demonstrates a similar trend despite having lower coverage and beginning in 2015. The stylized facts in this section present first pass evidence that firms that score higher on ESG metrics acquire a larger share of their debt financing from bond markets.

IV. Empirical Results

Next, I estimate the relationship between ESG scores and the share of debt financing from banks in a regression. I estimate the following regression at the firm-year level. I include time-varying firm-year controls and firm, year and credit rating fixed effects. I cluster standard errors at the firm level.

$$\frac{\text{Loans}}{\text{Debt}}_{it} = \beta(\text{ESG Bucket})_{it} + \gamma X_{it} + \alpha_i + \alpha_{CR} + \alpha_t + \epsilon_{it} \tag{1}$$

The time-varying firm controls include log assets, log sales, return on assets and firm leverage. I show the results below in Table 2.

Table 2 Baseline Results

	(1) Loans/Debt	(2) Loans/Debt	(3) log(L)	(4) log(B)
ESG Bucket	-1.524**	-2.605***	-0.127*	0.086**
	(0.601)	(0.926)	(0.069)	(0.042)
log(Assets)	0.275	7.293***	1.415***	1.103***
	(1.532)	(2.805)	(0.185)	(0.111)
log(Sales)	-0.228	-3.786	-0.112	-0.073
	(1.084)	(2.972)	(0.190)	(0.115)
ROA	-0.001	-0.012	-0.005	-0.000
	(0.037)	(0.058)	(0.006)	(0.002)
Debt / Assets	-3.897	-2.087	3.596***	3.221***
	(5.440)	(11.770)	(0.674)	(0.476)
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Credit Rating FE		✓	✓	✓
Observations	7243	2336	2053	2326
R^2	0.740	0.748	0.721	0.926

Columns (1) - (2) indicate that as firms increase their ESG score, they tend to borrow less from banks. In column (1) I present the regression with only the time-varying controls and firm and year fixed effects. Even after I include the credit rating fixed effect in column

(2), we observe a sustained negative coefficient estimate for the ESG bucket of the firm. In terms of economic significance, we observe that a one standard deviation increase in ESG scores (around 1.4 ESG buckets) corresponds to a 3-4 percentage point decrease in the share of bank loans.

In columns (3) and (4) I show the coefficient estimates for the (log) level of loans and bonds, respectively. The effect of ESG scores on the stock of bank debt outstanding is negative. In column (4), we observe that increases in ESG scores correspond to increases in bond financing. In terms of magnitudes, we observe that a one standard deviation increases in ESG scores corresponds to an approximately 15-20% increase in amount of bond capital outstanding.

A. Instrumental Variable Approach

In this section I present an identification strategy to address the potential for error-in-variables bias in the measurement of ESG scores, similar to the exercise conducted in Berg et al. (2021a). In general, the ideal experiment would involve randomly assigning one firm a more ESG friendly business strategy while leaving other firms unchanged. We would then expect the higher ESG firm to rely more heavily on bond markets to finance their operations. However, the goal of this section is not to precisely satisfy the exclusion restriction and provide a causal estimate of the relationship. The objective is to reduce the potential noise in the firm level ESG score estimate. I will consider the ESG scores of firms that compete with the underlying firm as the source of variation in ESG scores. The intuition for the first stage relationship is to identify a broad systematic technology shock that is out of the direct control of the firm in question. In this way we can identify true variation in ESG scores while also reducing reverse causality concerns.

To construct the instrument, I first sort the data into five size bins to account for the idea that firms of a similar size are more likely to compete with one another and adopt similar technology. Next, within each size bucket-year, I construct an average ESG score for each SIC2. Next I remove the ESG score of the underlying firm i in the average ESG for a given size-year-SIC1 combination to create an average ESG score of competitors:

$$\text{Comp. ESG}_{-i,t} = (\overline{ESG}_{i \epsilon S_i,t} - \frac{1}{|S_i|} ESG_i) \frac{|S_i|}{|S_i| - 1} \tag{2}$$

Armed with the competitor ESG variable, I then proceed to estimate the first stage to ensure that the inclusion restriction is satisfied.

$$\text{ESG}_{it} = \beta \text{Comp. ESG}_{-i,t} + \gamma X_{it} + \alpha_t + \alpha_i + \epsilon_{it} \tag{3}$$

In the first column of Table 3 I show the first stage results. The variable is highly significant with a high F-statistic of around 15, including controls. Intuitively this estimate de-noises the ESG score from potential measurement errors and focuses on variation that is more industry-wide rather than idiosyncratic. In the following two columns, I show the OLS and IV estimates of the main results for the loan share of total debt, respectively.

For example, in columns (2) and (3), we observe that using the IV produces a coefficient estimate for the ESG Bucket variable that is substantially larger than the OLS estimate. The IV estimate suggests that a one standard deviation increase in the ESG score of the firm would correspond to a change of around 19 percentage points. This is substantially higher than the estimate in column (2). Note that in this estimation I do not include credit rating fixed effects, due to the fact that the statistical power of the instrument decreases below the threshold for valid inference.

Table 3 Competitor ESG Instrument

	(1) ESG Bucket	(2) Loans/Debt	(3) Loans/Debt
ESG Bucket		-1.524**	-13.220**
		(0.601)	(6.512)
Comp. ESG	0.081***		
	(0.017)		
log(Assets)	0.184***	0.275	2.574
	(0.041)	(1.532)	(2.124)
log(Sales)	0.078***	-0.228	1.268
	(0.023)	(1.084)	(1.346)
ROA	-0.002***	-0.001	-0.018
	(0.001)	(0.037)	(0.042)
Debt / Assets	-0.173	-3.897	-4.607
	(0.120)	(5.440)	(5.854)
Firm FE	✓	✓	✓
Year FE	✓	✓	✓
Observations	6555	7243	6555
Method	First Stage	OLS	IV

The preceding analysis suggests that firms increase their bond usage as they increase their ESG score, while they either decrease or leave unchanged their bank financing. Next I study the degree to which ESG score changes transmit to the cost of debt capital for both market and bank financing.

B. ESG Scores and the Loan-Bond Spread

In this section I move from firm level data to security level data to study how the ESG qualities of firm disproprtionately affect the prices of bond capital versus loan capital. I build the rationale for the subsequent empirical design from from Schwert (2020), who studies the loan-bond spread and finds that banks charge a substantial premium over bonds, even after controlling for seniorage. The paper matches loan issuance to existing bond yields for the same firm-date observation. First, I collect all new loan issuance from

Dealscan during 2011 - 2020. I consider only loans classified as General Purpose, partially based on the methodology of Berg et al. (2021b). I match loans to the firm-level panel of financial statement data from Compustat and ESG score data from Refinitiv. Next, I match the dataset to secondary market bond yields by the same firm. I include only loan facilities where LIBOR is the base rate. I calculate the loan rate as the all-in-spread plus LIBOR. In Table 4 I show the summary statistics of the complete matched sample.

Table 4 Loan-Bond Matched

Year	N(L)	N(B)	Av(L Rate)	Av(B Rate)	Av(L)	Av(B)	Av(L Mat)	Av(B Mat)
2011	66	221	1.6	4.2	4.7	0.7	3.5	10.4
2012	59	244	1.6	2.7	4.5	0.8	3.7	11.5
2013	68	264	1.7	3.3	10.0	1.2	3.2	10.6
2014	59	212	1.5	3.1	5.1	0.8	3.2	10.0
2015	59	251	1.5	3.5	5.5	1.1	3.4	10.9
2016	62	301	2.0	3.3	9.1	1.0	2.8	11.1
2017	88	509	2.4	3.1	6.1	1.0	3.2	11.2
2018	110	423	3.5	4.2	8.3	1.2	3.1	12.1
2019	85	389	3.6	3.6	5.5	0.7	3.0	10.5
2020	89	651	2.1	2.7	4.1	1.0	2.6	12.0

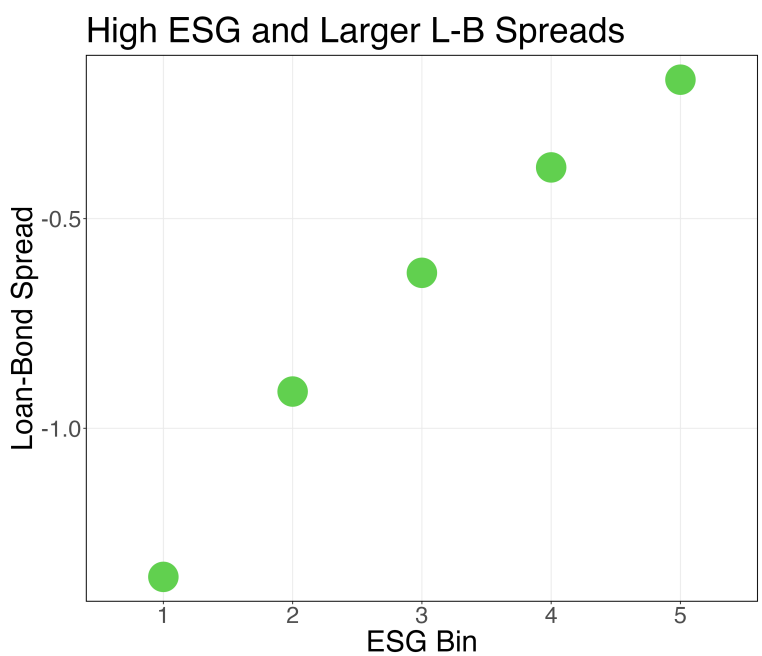
First, note in columns (2) to (3) that I match the issuance a single syndicated loan facility to multiple bonds for the same firm-month observation. In columns (4) and (5) we observe that the average loan facility has an interest rate that is lower than the average secondary bond yield (in basis points). Next, in columns (5) and (6) we observe that the average size of a loan facility is greater than the average bond outstanding amount. Lastly, in columns (7) and (8) we note that the average maturity of loan facility is much lower than the average maturity of outstanding bonds. I will include controls for the differences between these amounts in subsequent tests. The primary econometric test in this section involves studying whether the ESG score of a firm impacts the loan - bond yield spread,

where we are comparing the yields of new loan issuance to the yields of existing bonds outstanding that trade in the secondary market.

$$\text{L - B Spread}_{it} = Y_{Loan,i,t} - Y_{Bond,i,t} \tag{4}$$

First I show suggestive evidence of the channel. I first take the sample and subset to the closest maturity bond for each loan. Next, I split the ESG scores into 5 bins. Next, I subtract the average premium in each year-month to control for the average loan-bond spread in the period. I then calculate the average demeaned loan-bond spread for each bin. I show the results in Figure 3.

Figure 3. Loan-Bond Spread and ESG Scores



We observe that as we move up the ESG spectrum, the spread between loan yields and bond yields increases. This is suggestive evidence that higher ESG firms pay higher rates

on their bank loans versus their bond borrowing. Next, I control for other covariates and fixed effects in a regression. Formally, the regression takes the following form.

$$\text{L - B Spread}_{it} = \beta \text{ESG Score}_{it} + \gamma X_{it} + \alpha_{CR} + \alpha_i + \alpha_t + \epsilon_{it} \tag{5}$$

We would expect that the spread increases in the ESG score, yielding a positive beta estimate. The hypothesis is that increases in the ESG score of the firm will translate to lower bond yields relative to loan issuance yields. Because we are comparing two debt securities in the same time period, we essentially eliminate the concern that the firm's credit risk characteristics change between observing a loan issuance and a bond issuance. However, if ESG scores simply captured general credit risk (beyond the risk captured by the regression controls), then we would expect that ESG score increases would decrease a firm's valuation of the renegotiation option with the bank (Crouzet (2017)), decreasing their willingness to pay for bank loans. In other words, we would expect that the high ESG firm would not agree to the same high rate, decreasing the equilibrium rate agreed upon with the bank. In Table 5 I show the resulting estimates.

In column (1), I estimate the regression only with firm controls and firm and year-month fixed effects. We observe that ESG scores positively relate to the loan - bond spread. In column (2), I add controls for the differences in maturities and in sizes between the two debt instruments. In column (3), I subset to only matched loan-bond pairs. In terms of magnitudes, we observe that an increase in the ESG score of 19 percentiles (one standard deviation) corresponds to an approximately 20-25 basis point increase in the loan - bond yield spread, according to the two tighter specifications. This represents a significant discount on bond capital versus loan capital. In the second row, we observe unsurprisingly that as the maturity of the loan increases relative to the maturity of the bond, the loan-bond spread increases due to the term premium. This result provides direct

Table 5 Loan Bond Spread

	(1) L-B Spread	(2) L-B Spread	(3) L-B Spread
ESG Score	1.952**	1.046**	1.244**
	(0.867)	(0.508)	(0.603)
log(Assets)	-20.735	-47.264*	37.334
	(20.738)	(26.637)	(42.931)
Debt / Assets	-64.621	51.106	197.507*
	(89.537)	(100.311)	(102.872)
ROA	225.111***	18.664	100.350
	(72.581)	(91.591)	(153.080)
logSales	23.772	21.362	-73.620
	(24.991)	(29.508)	(45.149)
Maturity Diff.		72.964***	27.552**
		(5.542)	(13.590)
Size Diff.		6.751*	6.104
		(3.503)	(7.721)
Firm FE	✓	✓	✓
Credit Rating FE		✓	✓
Year FE			✓
Year-Month FE	✓	✓	
Observations	2572	2563	282
R^2	0.432	0.650	0.859
Sample	All	All	Closest Mat.

evidence that it is the asymmetric sensitivity of the two capital sources to ESG qualities that drives the differential propensity of higher ESG firms to tap bond markets.

I have also estimated a similar specification using ESG scores and corresponds bond and loan yields in primary markets separately. The results are similar where bond yields are more sensitive than loan yields to ESG scores. I display only the matched sample results as they provide a tighter comparison than the unbalanced issuance data.

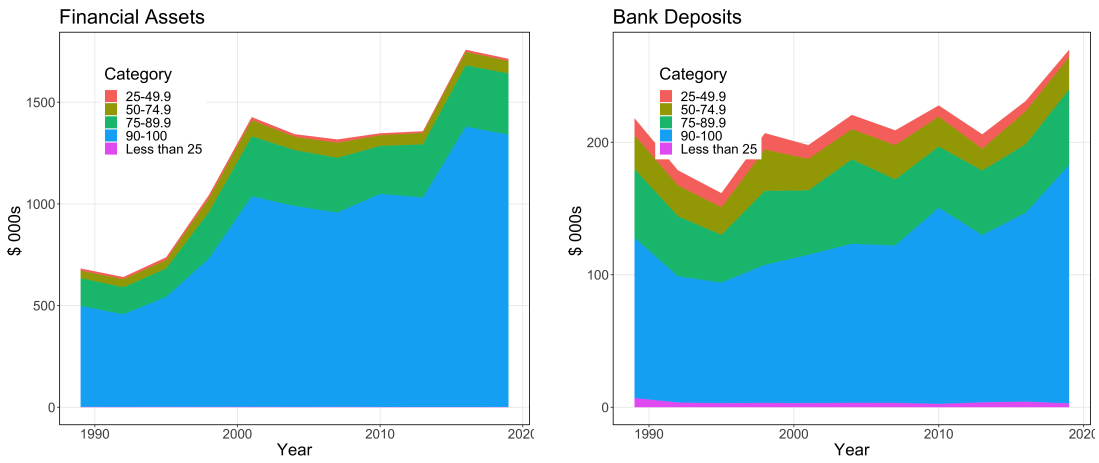
Until this point, I have shown that as firms go up (down) the ESG spectrum, they tend to use significantly less (more) bank debt relative to bonds, and that this effect is primarily driven by increases in bond usage, and a partial substitution between the two debt sources.

What is the mechanism that drives this result? I have argued that by controlling for the risk of the underlying debt I rule out a simple risk based mechanism whereby higher ESG firms are simply less risky, and thus place a lower value on the continuity of bank lending in times of financial distress. Furthermore, I control for the size of the firm to rule out a simple size based explanation where larger firms are easier to value and hence have less benefit from the monitoring of banks. The information sensitivity of deposits is left as the most likely candidate. Bank managers are primarily concerned with lending to profitable firms, and are likely less ESG sensitive than the representative investors which holds bonds. We would thus observe that the pricing kernel for bonds rewards higher ESG firms with a lower cost of capital, while loans outstanding would adjust only mildly in the opposite direction as loans become relatively more attractive for dirtier firms due to credit supply considerations. In the remainder of the paper I provide complementary evidence on the deposit insensitivity mechanism and I present a simple framework for studying counterfactual lending volumes if regulators forced firms to internalize the credit greenium.

C. Do Low ESG-Sensitivity Savers Hold Deposits and High-ESG-Sensitivity Savers Hold Bonds?

An alternative mechanism that could drive banks to be less sensitive to the ESG qualities of firms is that the average bank depositor is generally less concerned with ESG considerations while bond holders are a different type of more informed investors. To explore this hypothesis, I access the Survey of Consumer Finances from the Federal Reserve Board. I calculate the total bank deposits held by different net worth percentiles by summing the value of transaction accounts and certificates of deposit.

Figure 4. Asset Holdings by Net Worth Percentile



In the left panel we observe that the majority of financial assets are unsurprisingly held by higher net worth households. In the right panel we observe similarly that the majority of bank deposits are held by those same higher net worth percentiles. While this finding is unsurprising, it addresses a potential concern that the marginal provider of bank deposits exhibits a different ESG-type sensitivity when compared to the marginal provider of bond financing.

D. How Sensitive are Bank Depositors to the ESG quality of their bank?

In this section I present complementary evidence of the information insensitivity of bank deposits. I use Call Report data to study whether increases in ESG scores at a bank correspond to increasing deposit flows. Specifically, I download FR-Y9C regulatory data and I construct a measure of total deposits at the bank holding company level. [4] Next I match the bank deposit data to ESG scores at the annual level, leading to a unbalanced panel of 182 unique banks from 2011 to 2021. I estimate the following regression.

[4] I sum non-interest bearing deposits (BHDM6631 + BHFN6631) and interest bearing deposits (BHDM6636 + BHFN6636).

$$\text{Deposits}_{bt} = \beta \text{ESG Score}_{bt} + \alpha_b + \alpha_t + \epsilon_{bt} \tag{6}$$

We would expect that the beta estimate would reveal a weak correspondence between ESG qualities of a bank and subsequent deposit flows. In Table 6, I show the resulting coefficient estimates.

Table 6 Bank Deposits and ESG Scores

	(1) log(Deposits)	(2) log(Deposits)	(3) Δ Deposits	(4) Δ Deposits
ESG Score	0.001		-0.002	
	(0.003)		(0.002)	
Δ ESG		0.001		0.001
		(0.001)		(0.002)
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Observations	644	544	506	506
R^2	0.993	0.994	0.192	0.190

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

I show the regression in terms of the level of log deposits in the first two columns and in growth rates in the second two columns. We observe a consistently null effect of ESG scores on deposit flows, supporting the main hypothesis of the paper regarding the ESG-insensitivity of bank deposits.

V. Model of ESG-Tailored Capital Requirements

In this section I present a simple framework for studying the tradeoffs facing a policy maker that attempts to undo the ESG-mispricing identified in the paper. In order to better align bank lending incentivies with those of the representative investor, only along

the ESG dimension, how would the bank's broader portfolio change as a result? It could be that providing a new ESG-based incentive for banks would distort the bank's lending problem to dominate any gains in welfare terms. I present a model of bank loan provision under different capital requirement regimes and study the consequences of instituting of ESG-sensitive capital requirements. Crucially the goal of ESG-based capital requirements is not to improve the risk management strategy of the bank in classical terms, but rather it is to encourage banks to internalize the externality of their lending toward 'brown' firms in the same way bond markets do. This consideration is separate from credit risk which would already be incorporated in the day-to-day risk management operations in which banks specialize.

At this stage, the model features N firms that borrow from a single representative bank to finance their projects. Firms are heterogeneous along two dimensions. First, firms vary in the quality of their output technology. Second, firms vary in their ESG score. In the current version of the model, I take both objects to be exogenous. A more rigorous exercise would be to endogenize the ESG policy of the firm to study how firms ESG-investment policy evolves under different regimes, which I leave for subsequent work.

A. Firms

There are two periods $t = 0, 1$. The N firms operate in a perfectly competitive environment. Each firm possesses a simple technology that produces output according to $Y(L_j) = AL_j$ where $A \geq 1$. There is a source of aggregate risk $z_1 \in \{Good, Bad\}$, where $p(z_1 = Good) = p_z$. In addition to the aggregate risk, firms vary in the quality of their technology. In the good state, the project at firm j pays off AL_j with probability p_j, while in the bad state all projects payoff only the principal L_j. At time $t = .1$, z_1 realizes and all agents learn about the state of the aggregate economy z_1. In addition to varying in

the quality of their productive technology, firms also vary according to their ESG quality ESG_j. After setting up the standard restrictions implied by bank capital requirements, the key economic exercise studies the implications of different correlation structures between ESG_j and p_j. If regulators decided to implement an ESG-sensitive capital requirement, they would be altering the usual risk management problem of the bank and could produce unintended consequences.

B. Banks

The representative bank enters the period $t = 0$ with E_0 net worth. The bank sells deposits D to households inelastically at the policy rate f. The bank also makes loans to the N firms. At time $t = .5$, the bank (and the regulator) learns about the state of the world z_1 and must satisfy their capital constraint. In particular, the bank must issue costly equity if it is below its regulatory capital levels, where κ_j denotes the relevant capital requirement for each asset. The state-contingent equity issuance policy leads the bank to issue equity C_1 according to the increasing function $g(C_1(z_1)) = (1 + \phi)C_1$ if it is below its regulatory capital levels. The bank chooses a loan schedule, deposits, and a state contingent equity issuance policy to maximize expected net worth at the end of the period $t = 1$.

$$
\begin{aligned}
&\max_{L_{j\{j\in N\}},D,C_1(z)} \mathbb{E}[ME_1] \\
&\quad s.t. \quad E_0 + D_1 = \sum_{j\in N} L_j && \text{[Resource Constr.]} \\
&\qquad \pi_1(z_1) = \mathbb{I}(z_1 = Good)(\sum_{j\in N} p_j(A-1)L_j) - fD_1 && \text{[Period 1 Profit]} \\
&\qquad BE_1(z_1) = E_0 + C_1(z_1) + \pi_1(z_1) - \sum_{j\in N} c(L_j) && \text{[Earnings Process]} \\
&\qquad BE_1(z_1) \geq \sum_{j\in N} \kappa_j L_j \quad \forall z_1 \in \{Good, Bad\} && \text{[Capital Requirement]} \\
&\qquad ME_1 = BE_1(z_1) - g(C_1(z_1)) && \text{[Market Equity]}
\end{aligned}
\tag{7}
$$

Intuitively, the bank wants to choose a portfolio of loans that maximizes income in the good state of the world, while also incorporating the need to conduct a costly recapitalization in the bad state of the world. The forces that govern this baseline version of the model are present in many models of bank capital requirements (e.g. Corbae and D'Erasmo (2021), Whited et al. (2021)).

Note that in this case we have two states of the world so we have two Lagrange multipliers λ_G and λ_B corresponding to the shadow cost of the capital constraint in the good and bad states of the world. Solving for the FOC with respect to equity issuance yields a binding capital constraint in both states of the world due to complementary slackness condition. In the bad state of the world, the bank will need to issue costly equity to recapitalize.

If we impose the resource constraint and the capital constraints, then we get the amount of equity issuance in the bad state as a function of the optimal loan amounts:

$$C_B = \sum_{j \epsilon N} (\kappa_j + f) L_j + \sum_{j \epsilon N} c(L_j) - E_0(1+f) \tag{8}$$

Solving for the first order condition for the loan amount to each firm, we get the following simple loan schedule.

$$L_j^* = \frac{1}{\delta}(\underbrace{p_z p_j (A-1) - f}_{\text{Net Interest Margin}} - \underbrace{\frac{\phi}{1+\phi}\kappa_j}_{\text{Recapitalization Costs}}) \quad \forall \quad j \in N \tag{9}$$

Given the simplicity of the set-up whereby loan monitoring costs are additive, we note that the loan schedule depends only on characteristics of firm j. We observe that the optimal loan amount is increase in the net interest margin and decreasing in the recapitalization costs at time $t = .5$, which are a function of both equity issuance costs and capital charges. The key objective for regulators is thus to calibrate κ_{ESG} such that it internalizes the greenium that captures the social externality of dirty lending. The model above clarifies the tool of the regulator and I leave a full calibration of the model for future work.

C. Simple Application of the Model

In this section I provide an application of the above framework. In particular, I assume the existence of κ^*_{ESG} that perfectly alters banks' lending incentives to capture the greenium from the reduced form evidence presented earlier in the paper. That is, I assume κ^*_{ESG} encourages the bank to offer $r^*_{ft}(ESG_{ft}) = r_{ft} + \text{Greenium}_{ft}(ESG_{ft})$. As a strong simplification, I assume for simplicity banks respond inelastically along other constraints. This simplification allows for a focus on changes in credit flows holding all other factors constant.

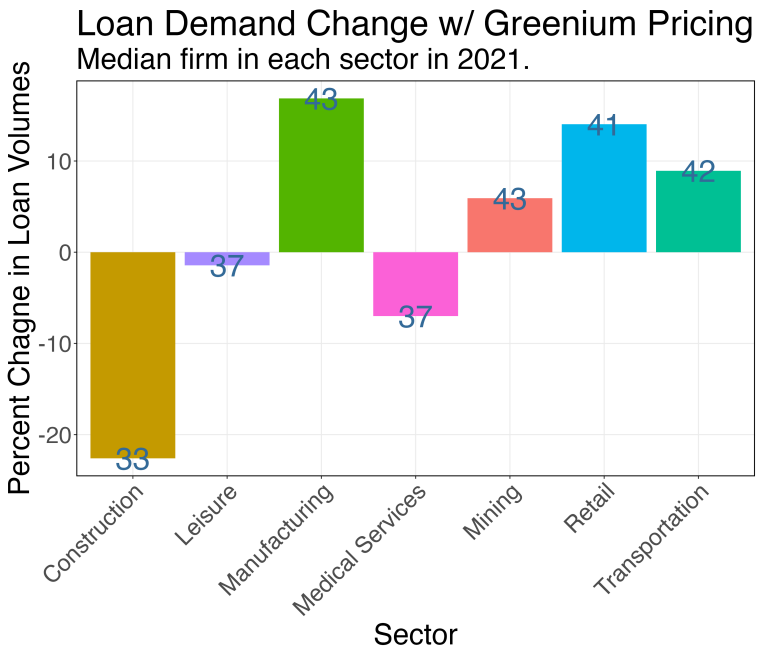
The key object needed to complete the approximation of counterfactual loan flows is the price elasticity of demand by firms. For simplicity, let us assume that firms have the following demand for loans: $L(r_j) = r_l^{-\epsilon_l}$. The critical parameter is the price elasticity of demand ϵ_l. I use an external estimate of this figure from Diamond et al. (2020), who estimates $\epsilon_l = -519$. This means that if a firm is half financed by bank loans, then a 10 basis point decrease in loan rates would increase the firm's loan share of financing by $.5 \times 51.9 = 25.9\%$.

In what proceeds I will focus on an industry level change in loan usage. First I subset the data to 2021. An important consideration when structuring ESG capital requirements is how to account for changes in ESG scores at the firm level and potential instability in bank's optimization problem over time. Leaving that instability to the side, I first subtract the median ESG score to create an equally brown penalizing and green adjusting factor. I then use this de-medianed score to construct a median ESG deviation for each sector. For the greenium calculation, I use the conservative estimate of 1.2 basis points per unit of ESG, taken from the reduced form evidence in Table 5. Putting the inputs together, I can approximate the hypothetical change in lending volumes to sector s in 2021 if banks fully internalized the greenium and otherwise responded inelastically. [5]

$$\% \text{ Change}_s = \epsilon_l \times \text{Greenium}_{s,2021}(\overline{ESG_{s,2021}}) \times \overline{\text{Loan Share}_{s,2021}} \tag{10}$$

Next I show the estimates at the sector level for seven different sectors. I show the percentage point change in loan volumes on the y-axis. I show the average ESG score for each sector overlaid on top of each bar.

[5] There are several important channels whereby banks might otherwise respond, reducing credit to certain firms as they expand credit to other firms. I leave this for future research.



We observe that loan volumes would decline by 22% for construction firms (lower ESG) and increase by 16% for manufaturing firms (high ESG). The critical question then becomes how does the substitution with bond finance work. I leave the substitution margin for future work. One complication with the exercise is ESG scores can change substantially year to year, which can impair existing assets on the bank's balance sheet.

VI. Conclusion

In this paper I evaluate the role of banks in financing a transition toward a sustainable economy. In particular, I evaluate the role of banks as capital providers relative to alternative sources. I show that as firms adopt more sustainable practices, they tend to increase their relative use of bonds substantially when compared to bank loans. I show that ESG score increases translate to lower costs of capital for bonds relative to loans. I argue that the nature of bank funding relative to bond investments accounts for the suggestive evidence of substitutions. Bond investors directly monitor their holdings, and

thus ESG conscious bond investors are more sensitive to variation in ESG scores. Bank depositors are 'sleepy' and thus the majority of bank financing is unconcerned with the exact asset distribution.

I present a simple framework for implementing ESG-sensitive capital requirements based on the cost of capital externality adjustment observed in bond markets. In future versions of the paper I plan to provide a more structured analysis of the welfare implications of such a policy, including the banking sector's aggregate lending effects. Overall, the paper highlights the strategic incentives of firms when trading off the costs of transitioning to a more sustainable business model and the corresponding cost of capital benefits provided by the market. Ultimately understanding the relationship between financial markets and firms' incentives to transition is of first order importance.

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Figure 5. Bank Debt Share, Robeco ESG Scores