Internet Appendix

Pension Deficits and the Design of Private Debt Contracts

We structure the Internet Appendix as follows. Section A provides an overview of the regulations of DB pension plans. We discuss how we address the joint determination of loan terms method in Section B. We discuss the results of additional robustness tests of the impact of DB pension deficits on the cost of borrowing in Section C.

A. Regulation of DB Pension Plans

The Employee Retirement Income Security Act of 1974 (ERISA) governs the regulation of DB pension plans. According to ERISA, plan sponsors are required to meet 90% of underfunded pension liabilities in the next 30 years. In addition, DB plans are subject to a number of accounting regulations, including SFAS 87, introduced in 1985, SFAS 132, introduced in 1997, and SFAS 158, introduced in 2006. Under SFAS 132, companies are no longer required to report separate items for overfunded and underfunded plans. The new accounting standard (SFAS 158) requires plan sponsors to account for estimated salary increases, in addition to current salary levels as adopted in SFAS 87. The US Congress also passed the Pension Protection Act (PPA) in 1987, which aims to improve the overall funding of pension plans by requiring severely underfunded firms to make "catch-up" contributions. The "catch-up" contribution ranges from 13.75% to 30% of the underfunding amount (Campbell, Dhaliwal and Schwartz, 2012). The PPA of 2006 made substantial changes in contribution requirements. For example, plan sponsors are now required to fully fund their DB plans within seven years instead of 30 years.

In addition to the above regulatory frameworks, the Pension Benefit Guaranty Corporation (PBGC), a government-owned entity managed by the US Department of Labor, protects the retirement income of employees covered by DB pensions plan. When an employer terminates a DB pension plan, the PBGC is responsible for meeting the pension obligations to the employees. However, the PBGC's liability is limited. In 2013, the maximum annual retirement benefit per retiree for single-employer plans was capped at US$57,477. For multi-employer plans, the guaranteed benefits are substantially smaller (Brown et al., 2013). Because of their insurance function, the PBGC charges a premium per plan participant that increases with the amount of underfunding. The PBGC also has the authority to force a plan to terminate if it does not meet statutory tests. In addition, plan sponsors may choose to freeze their plans to prevent accrual of new benefits.[1]

A pension plan is in deficit (underfunded) if its pension liabilities exceed its pension assets. Under ERISA, when the underfunding amount exceeds 10% of the plan's asset value, the sponsor is required to make a mandatory contribution to reduce the deficit within three to five years. However, the actual amount of contributions can vary. For example, if the pension fund falls short by 20% but stays below 10% in the preceding two years, the sponsor can avoid the required contribution. In addition, DB sponsors are allowed to request a hardship waiver or an extension of their contribution period (Franzoni and Marin, 2006).

Overall, DB pension plan regulations and the explicit insurance of DB pension benefits by the government (through the PBGC) highlight the importance of DB pension plans. In addition, the complexity of pension accounting and the fact that pension contributions are amortized over time indicate that it is rather difficult to correctly measure the exact amount of pension liabilities. This implies that the decision to fund DB pension plans could exacerbate information problems faced by the sponsoring firm. In addition, underfunded pension plans face

[1] For further details, see Brown et al. (2013).

the risk of making mandatory contributions and paying a higher insurance premium to the PBGC, which creates cash flow constraints.

B. 2SLS Model to Test the Joint Determination of Loan Terms

This section explains the 2SLS regressions employed to test the joint determination of loan terms, following Bharath et al. (2011), Dennis, Nandy and Sharpe (2000), and Hollander and Verriest (2016). Bharath et al. (2011) argue that loan price is determined after all other non-price terms are settled. Initially, the lead bank conducts due diligence and determines the non-price features. Then, the interest charged on the loan is determined following a book-building process to gauge the interest of potential lenders. Accordingly, loan spread has a unidirectional relation with other non-price loan terms, whereas the relation between loan maturity, covenant intensity, and collateral are bidirectional. We thus can express the relation between loan spread, loan maturity, covenant intensity, and security as follows:

(A1) $SPREAD_{i,j,t} = f(LNMATURITY_{i,j,t}, SECURITY_{i,j,t}, COVENANTS_{i,j,t}, DEFICIT_{i,t-1}, CONTROLS).$

Since loan maturity, security, and covenant intensity are endogenous variables, in the first stage of the 2SLS procedure, we estimate Equations (A2), (A3), and (A4) using the OLS, logit, and Poisson regression methods, respectively:

(A2) $LNMATURITY_{i,j,t} = f(IVs, CONTROLS),$

(A3) $SECURITY_{i,j,t} = f(IVs, CONTROLS),$

(A4) $COVENANTS_{i,j,t} = f(IVs, CONTROLS),$

where *IVs* denotes the set of instruments for loan maturity, security, and covenant intensity. We follow Hollander and Verriest (2016) and Bharath et al. (2011) to choose instruments for loan maturity and security (collateral requirement). The instrument for loan maturity is the average loan maturity in the preceding three months. The instruments for collateral requirement are loan concentration and the four-digit SIC industry median tangibility ratio.[2] With regard to covenant intensity, we use the 360-day historical default as an instrument. We measure historical default as the total size of the lead bank's defaulted loans in the preceding 360 days prior to the facility start date scaled by the total amount of defaulted loans experienced by the lead bank in the three years from year *t-4* to year *t-2* to adjust for the lead bank's history of delinquent loans, with *t* denoting the year of the facility start date.[3] We identify the lead lender for each loan facility using the Ivashina (2009) definition of the lead arranger role. In particular, we search for lenders identified as the administrative agent by Dealscan. If the loan does not have an administrative agent, we then search for the terms *agent*, *arranger*, *book runner*, *lead arranger*, *lead bank*, and *lead manager* in the lender role field. We remove loan observations whose lead banks are not identified. Our instrument for covenant intensity is motivated by Murfin (2012), who finds that the lead bank's recent default experience influences the strictness of covenants in subsequent loans.

From the first-stage equations, we obtain the fitted values for loan maturity, security, and covenant intensity and substitute these fitted values for the actual values for these variables in Equation (A1) in the second stage. In other words, we estimate the following equation using OLS:

(A5) $SPREAD_{i,j,t} = f(ELNMATURITY_{i,j,t,} ESECURITY_{i,j,t}, ECOVENANTS_{i,j,t}, DEFICIT_{i,t-1}, CONTROLS),$

[2] Loan concentration is measured as the current loan amount divided by the sum of the loan amount plus existing debt.

[3] To identify defaulted loans, we first identify defaulting borrowers using S&P monthly ratings. A company is in default if it has a "D" or "SD" rating by S&P. Using the GVKEY symbol and the date of the "D" or "SD" rating, we trace all outstanding loans of the defaulting borrower and the lead bank(s) of these loans.

where *ELNMATURITY* is the predicted value of loan maturity obtained from Equation (A2), *ESECURITY* is the predicted probability of loan security obtained from Equation (A3), and *ECOVENANTS* is the predicted value of covenant intensity obtained from Equation (A4). *CONTROLS* denotes all control variables outlined in Equation (2). We report the second-stage regression results in Table 4 of the paper.

C. Other Robustness Checks

In this section, we perform a battery of additional analyses and robustness tests on the impact of DB pension deficits on the cost of borrowing. We report the results in Table IA. First, to mitigate the influence of extreme observations, we use a median regression with robust standard errors to estimate Equation (2) and report the results in Model 1. The size and significance of the explanatory variables are consistent with our baseline results, indicating that outliers do not influence our baseline results.

Second, our loan observations are at the facility level. Given that multiple loan facilities might belong to the same loan package, cross-sectional regression standard errors may be biased, resulting in overstating the statistical significance of our results. To overcome this problem, we re-estimate the baseline model at the loan package level. However, important loan information, including maturity, security, type, and purpose, is lost when we examine loan packages. Therefore, rather than using loan packages, we restrict our sample to include only the largest loan facility per loan package per year, following Hasan et al. (2014). We then re-estimate Equation (2) for this sample of 7,683 loan facilities. As shown in Model 2, the results for this sample are consistent with our main results reported in Table 2 of the main text.

Similarly, loans initiated by the same lender have high correlation with one another, leading to biased standard errors. We address this concern by using a two-way firm-lead bank clustering method to adjust the standard errors. The final sample includes 3,928 observations. We report the results of this analysis in Model 3.

In addition, our results are robust to an alternative measure of total borrowing costs that includes various fees charged by lenders. We use the sum of loan spread, upfront fee, commitment fee, utilization fee, facility fee, and cancellation fee provided by Berg, Saunders and Steffen (2016) as a proxy for total borrowing costs. Model 4 reports the relation between pension deficit ratio and total borrowing cost. The positive and significant coefficient for the pension deficit ratio indicates that pension underfunding has a material impact on the overall cost of borrowing. Finally, we also restrict our sample to firms that are older than five years to ensure our results are not driven by firm age. The results are reported in Model 5. Overall, the coefficients of *DEFICIT* in all models in Table IA are positive and significant, consistent with the baseline results documented in Table 2 of the paper.

[Insert Table IA here]

We perform a number of additional robustness checks. First, we exclude financial years before 1987 due to the change in the requirement of mandatory contributions under PPA 1987. Second, to address the potential effect of firm cycle on pension funding status (for instance, older firms might have larger pension deficits as their pension contributions are accumulated over a longer period of time), we include the natural log of firm age as a control variable in Equation (2). Overall, our additional robustness checks presented in this section strongly support that the extent of pension deficits increases the cost of bank loans.

TABLE IA
Further Robustness Checks

This table presents various robustness test results on the impact of pension deficits on the cost of bank loans. The dependent variable in all analyses is the log of the all-in drawn spread variable obtained from Dealscan. In Model 1, we use the median regression with robust standard errors. In Model 2, we include only the largest loan facility within a loan package per year in our sample. In Model 3, we rerun Equation (2) with a two-way clustering of standard errors at the firm level and at the lender level. In Model 4, we use the overall cost of borrowing, including interest costs and other fees, as in Berg, Saunders and Steffen (2016) as the dependent variable. In Model 5, we require the sample firms to have at least five years of age. We cluster the standard errors at the firm level in Models 1, 2, and 5.We present *t* statistics in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide detailed description of the variables in the Appendix of the paper.

	Models				
	1	2	3	4	5
DEFICIT	0.2606	0.2415	0.2024	0.2484	0.2507
	(10.82)***	(4.80)***	(2.47)***	(5.32)***	(4.53)***
Constant	7.8938	5.1224	7.282	7.5576	5.4759
	(11.43)***	(12.51)***	(17.26)***	(28.52)***	(14.32)***
Loan syndication dummy	Yes	Yes	Yes	Yes	Yes
All other controls	Yes	Yes	Yes	Yes	Yes
Loan type and loan purpose fixed effects	Yes	Yes	Yes	Yes	Yes
Credit ratings fixed effects	Yes	Yes	Yes	Yes	Yes
Year and industry fixed effects	Yes	Yes	Yes	Yes	Yes
R2/Pseudo R2	0.5089	0.7206	0.6913	0.8196	0.7101
N	10,298	7,683	3,928	8,026	9,912

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