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# Credit Risk Management and US Bank-Holding Companies: An Empirical Investigation

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**Abstract:** This paper empirically evaluates the impact of ownership structure on the cost of credit in US banks. It does so by comparing their grouped option-adjusted credit spreads on the outstanding debt issues. As the overall risk of the creditors is reflected in the yield spread of the firms' outstanding bonds, separately classifying bank-holding companies and stand-alone banks and controlling risk ratings, maturities, and issue sizes enables us to compare the yield spreads tied to ownership structure. After computing the option-adjusted yield spreads of outstanding operating and holding company bonds, we used these values in a master regression equation to test the statistical and economic significance of the binary variable separating the option-adjusted spreads of the two sets. Our work finds that when the S&P ranks and maturities are controlled, US bank-holding companies finances with higher cost of credit compared with stand-alone banks, although holding companies add a layer of liability protection due to the legal separation between the assets and the owners. This suggests that certain characteristics of US bank-holding companies, such as higher leverage and higher systematic risk levels, make them riskier compared with traditional stand-alone banks, offsetting the benefits of forming a holding company.

**Keywords:** bond yield spread; US bank-holding company; leverage; option-adjusted spread; cost of credit

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## 1. Introduction

Banks are chartered institutions authorized to accept deposits, make loans, and provide a permissible range of financial services. In the US, banks are highly regulated institutions with access to the Federal Reserve System and classified as either traditional stand-alone banks or bank-holding companies. As highlighted in Boliari et al. (2023), "A bank-holding company (BHC) is not a bank itself but an entity that owns a controlling interest in one or more banks and exercises a controlling influence" on policies and management of the bank.[1] Bank-holding companies in the US are prohibited from acquiring a controlling interest in any company that is not a bank. Across the world, BHCs dominate the holding company counts where holding companies are legal entities. The US stands out, with approximately 25 percent of all holding companies being BHCs.

From a legal point, holding companies limit the legal as well as financial liability exposure, since they isolate the losses accrued by subsidiaries. This legal separation between the assets and the owners creates an added layer of liability protection. Theoretically, this added protection layer should lower the attributable risk of holding companies and is expected to lower the cost of credit for bank-holding companies. However, researchers evaluating the credit cost of BHCs do not have a consensus on the risk structure of BHCs. A quick literature review revealed that the pro-holding-company group highlights favorable points, such as growth opportunities, operating efficiencies, and different and more effective risk management that operating banks may not achieve.

In detail, this group underlines that, in addition to creating an added layer of liability protection, the BHC framework introduces greater diversification through a broader range of financial services that should result in lower idiosyncratic risk Demsetz and Strahan (1997). As reported by Hirtle (2016), BHCs are also subject to more disclosure requirements and supervision, and therefore considered less risky. Similarly, Galiay and Maurin (2015) and Ignatowski and Korte (2014) argued that markets should reward the BHSs prudent bank liquidity standards and capital composition that contribute to lower borrowing costs. Comizio et al. (2017) suggested that BHCs effectively separate troublesome subsidiaries and insulate them from potential liability. BHCs can offer additional financial products and services, increasing market share and revenue. Anenberg et al. (2018) highlighted that BHCs can achieve greater cost efficiencies and offer more competitive prices. They also underline that BHCs' ability to deal with both lending and underwriting usually lowers the prices of those services. Brandao-Marques et al. (2020) discussed the impact of a bank's portfolio of activities and the connection between a bank's approach to risk-taking and government support. They concluded that there was a positive relationship between the two and it also had an impact on the cost of credit. Chami et al. (2022) highlighted the enhancements created by maintaining both a trading desk and a loan desk, but warned of the potential issues of overleveraging and possible rogue trading activities.

Lee and Sabourian (2007) and Cetorelli and Goldberg (2014) discussed the riskiness of the BHCs within the complexity theory and the impact of structural complexity on bank-holding companies. Within the same context, Cuong (2021) elaborated on the BHCs' insolvency risks and concluded that it was not excessively high, and this was probably because of the existence of a greater number of subsidiaries and structural complexity. On the other hand, the opposing group criticized BHCs by pointing out their problematic characteristics. They highlighted that BHC formation would raise the cost of credit. Demsetz and Strahan (1997) pointed out BHCs' higher systematic risk and tied it to their higher use of leverage after highlighting their lower idiosyncratic risk and superior diversification. Stiroh and Rumble (2006) and Yang and Brei (2019) found that an increase in exposure to nontraditional banking activities of BHCs may offset the benefits of diversification since those activities are riskier, but do not compensate for the risk. Luciano and Wihlborg (2018, 2023) suggested that BHCs should have a higher cost of debt, and this should be attributed to their higher leverage compared with traditional stand-alone operating banks. In their study, they highlighted the importance of the constraints in BHCs' capital requirement and organizational choices. Gong et al. (2018) also underlined the association between the BHCs' risk level and capitalization ratio. There is a significant amount of literature covering the structural complexity of bank-holding companies and its negative impact on riskiness and cost of credit. For example, Buch and Goldberg (2022), Correa and Goldberg (2022), Chernobai et al. (2021), Flood et al. (2020), and Goldberg and Meehl (2020) provided evidence of the connection between operational risk and greater business complexity. In addition, Carmassi and Herring (2016) found that complexity was connected to large mergers and acquisitions, and the impact was significantly visible, even when the time was controlled. Argimón and Rodríguez-Moreno (2022) used Spanish confidential supervisory data and disclosed that greater complexity on the organizational side raised the risk, but greater geographic complexity lowered the risk.

Boliari et al. (2023) reported that, in supporting the second group, the European Union's resolution plan requires that "in the event of bank distress, the losses of a failing subsidiary bank be transferred to the holding company". Similarly, the Dodd–Frank Act requires the BHC to serve as a "source of strength" for any subsidiary. Boliari and Topyan (2022) highlighted the drawbacks of holding companies' inevitable involvement in business policy decisions with limited familiarity. In conclusion, our literature review suggests that the net effect of forming a BHC on credit financing is uncertain.

Using US bank holding company data, this study investigates the association between ownership structure and the credit cost for BHCs in relation to their traditional stand-alone counterparts under proper controls. We contribute to the literature by evaluating banking in the U.S. by separating it into two main classes, stand-alone and holding banks, with controlling bond characteristics, such as their maturity, risk ranking. Secondly, to the best of our knowledge, we are the first to compare the bonds issued by BHCs and stand-alone banks using option-adjusted spreads. This method enables us to compare and contrast the credit yields of different types of bonds, regardless of the options embedded in them.

This paper is organized as follows. The next section introduces the hurdles of callable bond return computations and highlights the importance of option-adjusted spreads as a way to deal with callable bond returns. Section 3 provides the model with the mechanics of option-adjusted spread computations. Section 4 displays and discusses the computed OAS values, Section 5 shows the estimation results, and Section 6 discusses and concludes this study.

## 2. Fixed Income Securities and Their Returns

Creditor–investors, (aka bondholders) deal with a variety of risks, such as liquidity, reinvestment, default, and early redemption. They require adequate compensation for the risks they are facing. As borrowers of capital, bond issuers, on the other hand, are the counterpart of the equation. The issuers' perceived risk level is a very important variable in the basic valuation equation and directly signals the expected return the bondholders would require. Accordingly, bond investors would like to measure a bond's yield spread to quantify the expected return implied by the bond's future cash flows in exchange for the purchase price. A bond's rate of return is what a purchaser would receive if the bond were held to a specific redemption date.

It is well-known to practitioners that yield or return computations require knowledge of future cash flows. The reliability of the yield analysis depends on the clarity of the future cash flows. Simple cash flows created by non-callable conventional bonds' coupons and interest payments, together with well-known maturity dates and regular payment intervals, make them directly comparable to a reference benchmark with similar features, such as maturity and riskiness. The spread differential of a similar risk-free issue may be interpreted as the incremental return earned from the non-benchmark issue.

However, the hurdles of yield spread computations of callable bonds require special attention. Unlike a non-callable bond whose cash flows are not connected to the level of interest rates, many fixed-coupon callable bonds have payment streams connected to the prevailing level of interest rates. These bonds contain provisions allowing early retirement so that the principal may be paid in whole or in part earlier than the stated maturity. This optionability breaks down the yield spread analysis with more than one possible redemption date. Having more than one possible redemption date makes future cash flows not clearly defined, forcing us to assume a redemption date to compute the yield. An uncertain redemption date causes ambiguity, since the number of coupon payments depends on the redemption date. And the redemption date is also connected to traditional price sensitivity indicators, such as convexity. Not knowing the exact redemption date introduces continuous uncertainty during most of the security's life that will last until just before the actual redemption date. In the end, the reliability of yield–spread analysis depends on the ability of a researcher to correctly guess the actual redemption date. If the assumed redemption date is different than the actual one, the entire yield-based analysis becomes irrelevant. This implies that, if the measurement of the return is flawed, drawing incorrect conclusions about the return and underlying risk becomes likely.

Moreover, predicting a future redemption date of an option-embedded bond without a proper risk model is a very difficult task as it is connected to the unknown and difficult-to-predict future interest rates. Miller (2007) finds this "the most significant risk. . . arguably surpassing the default risk." As for bond investors, any option embedded in favor of the issuer is harmful, since a change in rates can make the issuer call the bond, terminating the investors' favorable returns, leaving the bond investors with unfavorable rates prevailing at that point in time. On the other hand, if the rates were to move up, the bond investors would stock with a rate well under the prevailing ones or sell the bond at a discount.

Unlike traditional yield-spread analysis, OAS analysis, using an option-pricing model, converts all possible early redemption dates into alternative cash-flow streams using a probabilistic lattice covering the entire potential life of the option-embedded bond. This will obviate the need to predict a bond's likely redemption date. These provisions are called the embedded options and they are not separately written contracts, but they replicate hypothetical scenarios that the bond may be called earlier. In this sense, they operate like portfolios having a long non-callable bond and a short American call option written on the callable bond. The bondholders will short the American call and the bond issuers will long those call options. The value of the non-callable bond plus the value of the call option written on it would constitute the value of the portfolio that is equal to the value of the callable bond.

Using option-adjusted spreads instead of standard yield spreads, we incorporate the risk attributable to debt as well as cash-flow-related contingencies. Option-adjusted spreads were used by several researchers in different contexts. Cavallo and Valenzuela (2010) used option-adjusted spreads in emerging markets, Bierens et al. (2003) used the method for corporate bond portfolios, Boyarchenko et al. (2019) used it for mortgage spreads, and finally Letizia (2012) used it for an assessment of bank capital adequacy. However, this study is the first one using it to compare the cost of the debts of US stand-alone banks and bank-holding companies.

The issuer's spread measured in basis points is to be added to risk-free rates of return and represents the incremental return of the bond. Bond investors gauge the value of a bond by comparing the yield against all risks contained in the bond. Regarding the limitations of the model, Fabozzi (2006, p. 310) underlines that "a binomial option pricing model suffers from the assumptions that the prices are normally distributed and that the short-term interest rate and the variance of prices are constant over the life of the option." Fabozzi (2006) suggested that using return-based models, similar to the one used in our work, may mitigate this problem partially and they are, by definition, arbitrage-free. As underlined by Fabozzi (2006, p. 341), OAS is not a valuation model, but a product of a valuation model. This implies that, if a poor valuation model is used, the OAS values will be less meaningful.

## 3. The Model

This work uses a model with two separate stages. The first stage may be considered as data gathering for the master regression equation that needs the option-adjusted spread values of all S&P-rated outstanding bonds to test if they are different statistically and economically for the stand-alone banks and bank-holding companies. In the second stage, we regressed the first stage's computed option-adjusted spread values on an intercept, an ownership structure dummy separating BHCs and traditional operating banks, control variables for the S&P rating, issue sizes, and a decimalized bond maturity variable. Using OLS estimation, we then tested if the coefficient separating the two groups was statistically significant. It was hypothesized that the bank-holding companies would bear more overall risk and, therefore, a higher cost of debt. The sample comprised 4442 corporate bonds, of which 4149 were BHC bonds. We obtained the data using Bloomberg terminal on 15 February 2023.

In more detail, the first stage obtains obtained the option-adjusted spread values of all rated outstanding bonds using the model outlined by Miller (2007). For each bond, we used the callable-bond equivalency equation:

$$B_c = B_{ub} - C \tag{1}$$

where $B_c$ is the computed value of the callable or option-embedded bond, $B_{ub}$ is the value of the non-callable bond, and C is the value of the call option combining the intrinsic value and time value. The model uses a one-factor, arbitrage-free binomial tree of normally distributed short rates in order to establish a distribution of several different interest rate scenarios, which are driven by the volatility input for the interest rate. As a result, the option-adjusted spreads model considers the bond's call schedule to establish the evolution of rates over time by treating the implied forward rates as outcomes of a binomial process. Specifically,

$$V(R) = \frac{\left(\frac{1}{\sqrt{\Delta t}}\right) \cdot \ln\left(\frac{R_H}{R_L}\right)}{2} \quad (2)$$

where V(R) is the volatility of the short rate as a percentage, $\Delta t$ is the time period in years, $R_H$ is the possible high value of the short rate R, and $R_L$ is the possible low value of the possible outcome of short rate R.[2]

Equation (2) may be written for $R_{High}$ and $R_{Low}$ as

$$\ln\left(\frac{R_H}{R_L}\right) = 2V(R)\sqrt{\Delta t} \quad (3)$$

Equation (3) may be written as

$$\frac{R_H}{R_L} = e^{\ln\left(\frac{R_H}{R_L}\right)} = e^{2V(R)\sqrt{\Delta t}} \quad (4)$$

Rearranging Equation (4) yields the following outcome-producing form:[3]

$$R_H = R_L \cdot e^{2V(R)\sqrt{\Delta t}} \quad (5)$$

Ultimately, the OAS values represent the market's reaction to the risk structure of the fixed-income securities traded in the market. After we obtain the bond-specific OAS values using the binomial model explained above, in the second stage of this study, we run Equation (6) below to test the hypothesis of whether US bank-holding companies have a higher cost of debt compared with stand-alone banks.

$$OAS_i = \alpha + \beta\ OpCo_i + \Sigma_j\ \delta_j\ Controls_{j,i} + \varepsilon_i, \quad (6)$$

Equation (6) was estimated using OLS with the regression parameters of $\alpha$, $\beta$, $\delta_j$, and $\varepsilon_i$, and $OAS_i$ for bond i. Our dummy variable $OpCo_i$ = 1 (0) for bond i for stand-alone (holding) banks.

Equation (6) regresses the OAS values obtained in the first stage on an intercept and ownership structure binary variable, issue size, plus controls for the S&P risk rankings and a decimalized maturity variable. The equation checks if the ownership dummy, $\beta$, separating the OASs of bank-holding companies is statistically and economically significant. All other exogenous variables control the riskiness, maturity, and the issue sizes of the bonds. If the coefficient of the ownership dummy is not statistically significant, we conclude that the difference in riskiness, and therefore the returns of the stand-alone banks and bank-holding companies, is not statistically and economically significant.

## 4. The OAS Values for Operating and Holding Companies

Tables 1 and 2 provide the mean OAS values obtained in stage 1 and also show the count distribution of US outstanding bank-holding (Table 1) and operating company (Table 2) bonds classified using standard Treasury maturities and S&P rankings. The OAS mean column shows the mean OAS cell value obtained using the number of bonds shown in the count column. For example, the OAS value of 67 basis points corresponds to LT 1 year and the S&P rank of A is the average of 65 bonds' OAS values. Similarly, if we move down to BBB+ bonds, we have 187 such bonds in the corresponding cell, with an average OAS value of 109 basis points.

**Table 1.** The count distribution of the mean option-adjusted spread values and the mean OAS values for the outstanding bank-holding company bonds for standard US Treasury maturities and S&P rankings. The count column shows the number of bonds in the corresponding cell used to compute the average OAS. (Created by the authors using Bloomberg terminal accessed on 15 March 2023).

| OUTSTANDING BANK HOLDING COMPANY BONDS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Count** | **OAS Mean** | **Count** | **OAS Mean** | | |
| LT 1 year | A | 65 | 67 | 5 | 109 | A+ | 5 to 7 years |
| | A− | 117 | 164 | 35 | 137 | A | |
| | BBB+ | 187 | 109 | 214 | 166 | A− | |
| | BBB | 11 | 83 | 223 | 173 | BBB+ | |
| | BBB− | 37 | 237 | 9 | 197 | BBB | |
| 1 to 2 years | A+ | 4 | 12 | 20 | 263 | BBB− | |
| | A | 72 | 90 | 2 | 289 | BB+ | |
| | A− | 120 | 96 | 3 | 133 | A+ | 7 to 10 years |
| | BBB+ | 186 | 88 | 40 | 163 | A | |
| | BBB | 17 | 94 | 202 | 182 | A− | |
| | BBB− | 63 | 184 | 226 | 210 | BBB+ | |
| 2 to 3 years | A+ | 2 | 52 | 12 | 230 | BBB | |
| | A | 52 | 96 | 19 | 297 | BBB− | |
| | A− | 141 | 101 | 1 | 0 | BB+ | |
| | BBB+ | 215 | 107 | 3 | 185 | A+ | 10 to 20 years |
| | BBB | 16 | 114 | 43 | 184 | A | |
| | BBB− | 82 | 185 | 288 | 192 | A− | |
| | BB+ | 1 | 276 | 350 | 242 | BBB+ | |
| 3 to 5 years | A+ | 4 | 82 | 21 | 252 | BBB | |
| | A | 67 | 105 | 2 | 308 | BBB− | |
| | A- | 292 | 137 | 1 | 293 | BB+ | |
| | BBB+ | 414 | 144 | 3 | 72 | A | 20 to 30 years |
| | BBB | 22 | 130 | 53 | 188 | A− | |
| | BBB− | 91 | 234 | 47 | 221 | BBB+ | |
| | BB+ | 2 | 369 | 13 | 260 | BBB | |
| | | | | 1 | 324 | BBB− | |
| | | | | 19 | 55 | A | 30+ years |
| | | | | 7 | 21 | A− | |
| | | | | 7 | 284 | BBB+ | |

In an earlier study, due to the unavailability of individual OAS values of all the bonds evaluated, Boliari and Topyan (2022) used an alternative procedure and tested if the mean differences in the OAS values of comparable cells were statistically significant. Their work showed that the differences in means were statistically significant, but they could not measure the economic significance. However, our current study managed to obtain the individual OAS values of about 4000 outstanding bonds, enabling us to test the master regression equation that regressed the individual OAS values on an intercept, a binary variable separating the bank-holding companies from the stand-alone banks, and the controls for the issue sizes, maturities, and risk ratings of bonds.

**Table 2.** The count distribution of the mean option-adjusted spread values and the mean OAS values for the outstanding *stand-alone bank* bonds for standard US Treasury maturities and S&P rankings. The count column shows the number of bonds in the corresponding cell used to compute the average OAS. (Created by the authors using Bloomberg terminal accessed on 15 March 2023).

| **OUTSTANDING STAND-ALONE BANK BONDS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Count** | **OAS Mean** | **Count** | **OAS Mean** | | |
| LT 1 year | A+ | 4 | 26 | 3 | 175 | A+ | 5 to 7 years |
| | A | 8 | 82 | 1 | 97 | A | |
| | A− | 9 | 86 | 5 | 165 | A− | |
| | BBB+ | 3 | 38 | 3 | 207 | BBB+ | |
| | BBB | 3 | 88 | 6 | 263 | BBB | |
| 1 to 2 years | A+ | 9 | 50 | 2 | 253 | BBB− | |
| | A | 7 | 53 | 19 | 143 | A+ | 7 to 10 years |
| | A− | 6 | 82 | 15 | 0 | A | |
| | BBB+ | 1 | 124 | 2 | 192 | A− | |
| | BBB | 1 | 98 | 2 | 260 | BBB+ | |
| 2 to 3 years | A+ | 7 | 61 | 1 | 260 | BBB | |
| | A | 5 | 55 | 1 | 265 | BBB− | |
| | A− | 16 | 90 | 39 | 152 | A+ | 10 to 20 years |
| | BBB+ | 5 | 152 | 4 | 59 | A | |
| | BBB | 1 | 172 | 6 | 182 | A− | |
| 3 to 5 years | A+ | 13 | 121 | 9 | 252 | BBB+ | |
| | A | 7 | 82 | 2 | 343 | BBB− | |
| | A− | 9 | 129 | 10 | 45 | A+ | 20 to 30 years |
| | BBB+ | 7 | 175 | 1 | 28 | A | |
| | BBB+ | 3 | 204 | 2 | 297 | BBB+ | |
| | BBB− | 1 | 210 | 17 | 45 | A | 30+ years |

## 5. Estimation and Results

We ran Equation (7), the explicit form of Equation (6), to test the hypothesis that bank-holding companies have a higher cost of debt attributable to their risk structure.

$$OAS_t = \propto + \beta\,(\boldsymbol{H})_t + \gamma\,\boldsymbol{M}_t + \delta\,\boldsymbol{S}_t + \theta(\boldsymbol{A})_t + \varphi(\boldsymbol{A}-)_t + \omega(\boldsymbol{B3}+)_t + \vartheta(\boldsymbol{B3})_t + \varepsilon_t \quad (7)$$

where $\boldsymbol{H}$ is the binary that separates operating and holding companies so that it is 0 if the bond is a holding company bond and 1 otherwise; $\boldsymbol{M}$ is the decimalized maturity variable that is one year is equal to 1.0; $S$ is the issue size in million dollars, $\boldsymbol{A}$ is S&P rank A, $\boldsymbol{A}-$ is S&P rank A−, ***B3+*** is S&P rank BBB+, and ***B3*** is S&P rank BBB. All these controls are binaries classifying the bonds using their S&P rank. Their value is 1 if they are in the rank, and zero otherwise.

The hypothesis would be supported via a negative and statistically significant coefficient of the dummy variable $\boldsymbol{H}$ in Equation (7). If the coefficient is not statistically significant, we can conclude that the costs of credit financing are not statistically different for the US bank-holding companies and stand-alone banks.

The results obtained from Equation (7) are as follows:

$$OAS_t = 157 - 22\boldsymbol{H}_t + 3.03\,\boldsymbol{M}_t - 87(\boldsymbol{A})_t - 51(\boldsymbol{A}-)_t - 53(\boldsymbol{B3}+)_t - 27(\boldsymbol{B3})_t + \varepsilon_t \quad (8)$$

The detailed statistics of Equation (8) are provided in Table 3. One highlight is that all t-statistics, except for the issue size, are significant at a 5% level or better.

**Table 3.** Regression results obtained from Equation (7). Coefficients are in basis points.

| Regression Statistics | | Coefficients | | Standard Error | t Stat |
|---|---|---|---|---|---|
| Multiple R | 0.169 | Intercept | 157.61 | 7.65 | 20.61 |
| F-Stat | 17.33 | Issue Size | 0.00 | 0.00 | −0.82 |
| | | Maturity | 3.03 | 0.40 | 7.60 |
| | | H = 0 | −22.55 | 11.65 | −1.94 |
| | | A | −87.28 | 11.56 | −7.55 |
| | | A− | −51.88 | 8.57 | −6.05 |
| Standard Error | 144.00 | BBB+ | −53.44 | 8.29 | −6.45 |
| Observations | 3457 | BBB | −27.36 | 14.53 | −1.88 |

Table 3 presents the results obtained from our first regression with controls of the issue size, maturity, and binary variables for ***A***, ***A***−, ***BBB+***, and ***BBB*** categories and the binary variable that separates the bank-holding companies, ***H* = 0**. Since the issue size information is not available for all outstanding bonds and the initial regression reveals that the issue size is not a statistically significant variable, as an alternative regression, we removed those bonds from the date, lowering the number of observations from 3457 to 3419. Equation (9) shows the new regression without the issue size as a control.

$$OAS_t = \propto + \beta \boldsymbol{H}_t + \gamma \boldsymbol{M}_t + \theta(\boldsymbol{A})_t + \varphi(\boldsymbol{A}-)_t + \omega(\boldsymbol{B3}+)_t + \vartheta(\boldsymbol{B3})_t + \varepsilon_t \quad (9)$$

Equation (10) below shows the computed coefficient values obtained from the master regression Equation (9). Table 4 shows the detailed statistics.

$$OAS_t = 153 - 42.65\boldsymbol{H}_t - 2.54\boldsymbol{M}_t - 78.10(\boldsymbol{A})_t - 42.98(\boldsymbol{A}-)_t - 45.35(\boldsymbol{B3}+)_t - 18.04(\boldsymbol{B3})_t + \varepsilon_t \quad (10)$$

**Table 4.** Regression results obtained from Equation (9). Coefficients are in basis points.

| Regression Statistics | | Coefficients | | Standard Error | t Stat |
|---|---|---|---|---|---|
| Multiple R | 0.185 | Intercept | 152.59 | 7.53 | 20.25 |
| F-Stat | 16.95 | Maturity | 2.54 | 0.38 | 6.64 |
| | | H = 0 | −42.65 | 10.80 | −3.95 |
| | | A | −78.44 | 11.43 | −6.87 |
| | | A− | −42.98 | 8.38 | −5.13 |
| Standard Error | 143.94 | BBB+ | −45.35 | 8.13 | −5.58 |
| Observations | 3419 | BBB | −18.04 | 14.34 | −1.82 |

As Table 4 highlights, all explanatory variables, except BBB (about 5%) were statistically significant at the 1% level or better. The coefficient (M) had a positive sign, suggesting an upsloping yield curve. All S&P rankings had statistically significant negative signs. As an example, the coefficient value of −78.44 for the A-rated bonds provided the bond investors with a 78 basis point lower spread, on average.

The statistically and economically significant holding company dummy was equal to −42.65 basis points. This shows that the cost of debt increased by 42 basis points for the bank-holding company bonds compared with stand-alone banks.

## 6. Discussion & Conclusions

This study measured the yield spreads of bank debts by grouping them using the ownership structure to understand the impact of ownership structure on riskiness. To that end, this study checks if bank-holding companies would be able to lower the overall risk so that the bank will be considered a lower-risk and subsequently can finance with lower-cost debt compared with stand-alone banks. As highlighted in several previous research papers, bank-holding companies have structural complexity, lower capital ratio, and a larger loan portfolio, creating higher systematic risk, and their exposure to nontraditional banking activities usually offsets the benefits of diversification, as those factors contribute to raising their cost of credit financing. However, the added layer of liability protection, the greater diversification through a broader range of financial services BHCs offer should result in lower idiosyncratic risk, and their higher disclosure requirements would lower their cost of credit financing.

Until recently, data-related difficulties and a lack of experience in using option-adjusted spreads, there had been no studies testing the net effect. Researchers of US banking have been dealing with, on one hand, the expected positive impact of an added layer of liability protection of BHCs on the cost of debt, and on the other hand, the listed issues of the BHCs potentially raising the cost of credit. The hypothesis, therefore, was begging to check the perceived financial benefits of the bank-holding companies: Do BHCs help in lowering the cost of credit? The discovery of ownership structure-related data motivated us to test this hypothesis. The next hurdle of the ability to compare the option-embedded bond returns with the non-callable bonds was handled by the use of option-adjusted bond spreads.

This study concluded that US bank-holding companies, on average, finance with 42 basis point extra cost of debt compared with traditional operating banks. The coefficient of the dummy separating the holding company spreads from the stand-alone ones was statistically and economically significant, with a t value of 3.95 and equal to 43 basis points. The most important implication of our results is that knowing the average credit cost differences between bank-holding companies and stand-alone banks helps potential decision-makers to better visualize the consequences of converting to a bank-holding company. Additionally, the basis-point difference might change depending on the impact factors involved on the positive and negative sides. This issue should be studied by researchers to understand the relative importance of the contributing factors.

Luciano and Wihlborg (2018, 2023) highlighted a higher cost of debt for the BHCs, mostly regarding their leverage characteristics. Our analysis shows that forming a bank-holding company in the U.S. increases the total overall risk of the bank compared with stand-alone banks, causing bank-holding companies to finance with higher-cost debt. Our results underline that bond investors are well aware of the issues the BHCs have and they price the BHC bonds accordingly.

For future research, it would be interesting and beneficial to study the impact of the ownership structures of several different types of holding companies in different countries to determine the impact of country-specific risks and legal issues that are potentially different around the world.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Notes

[1] As Brahmbhatt (2008) noted, there could be visible differences in defining a holding and subsidiary company, since different countries take different stands on the issue, mostly from a legal perspective.

[2] As Fabozzi (2006) underlined, it is assumed that a "one-year forward rate can evolve based on a random process called a log-normal random walk with a certain volatility." (Fabozzi 2006, p. 326).

[3] As a practical example, if the model uses 6-month divides, then $\Delta t = 0.5$ years. If we assume a volatility level of 10%, setting $V(R) = 0.10$, the equation yields $R_H = R_L$ (1.15191).

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