

Taxes and the Pricing of Government Sponsored Entity Bonds

Adrian M. Cowan
Department of Finance
University of Alabama at Birmingham
School of Business
1150 10th Avenue South
Birmingham, AL 35294
Phone: (205) 975-5490
e-mail: acowan@business.uab.edu

Robert T. Petrine
Office of Finance
Federal Home Loan Banks
11921 Freedom Drive, Suite 1000
Reston, VA 20190
Phone: (703) 487-9578
e-mail: petrine@fhfb-of.com

September 2002

The authors are grateful for the invaluable research assistance of _____ and the helpful comments of Chuck Cowan.

Taxes and the Pricing of Government Sponsored Entity Bonds

Adrian M. Cowan

University of Alabama at Birmingham

Robert T. Petrine*

Office of Finance, Federal Home Loan Banks

Abstract

The bonds issued by government-sponsored entities (GSEs) represent Triple-A, "credit enhanced" debt. While this debt trades as a product class, the bonds of each agency are not perfect substitutes for one another. In addition to differences between agencies themselves, the bonds differ by tax status and liquidity. This paper analyzes the liquidity and tax effects reflected in the yield differentials of GSEs using several methodologies, including the identification of bond pairs. We provide evidence of investor segmentation within the GSE markets, but fail to show that this segmentation results from taxation differences among GSE bonds.

Keywords: bonds, government sponsored entities, taxes

JEL Classifications: G10

**Corresponding author:* Office of Finance, Federal Home Loan Banks, 11921 Freedom Drive, Suite 1000, Reston, VA 20190; Phone: (703) 487-9578; Fax (703) 787-3786 e-mail: petrine@fhlb-of.com

The authors are grateful for the invaluable research assistance of Diane Gross, Susan Goubeaux, and Yang Li of the Office of Finance and to Charles Cowan for helpful comments on earlier drafts of the paper.

1. Introduction

A state income tax exemption is provided to investors holding certain government sponsored entity (GSE) securities as afforded by 12 USC 1433. The purpose of this paper is to empirically investigate the value of this tax benefit. In general, the bonds of the Federal Home Loan Bank (FHLB), Sallie Mae, and the Federal Farm Credit Bank enjoy the same tax status as Treasury securities. Fannie Mae and Freddie Mac do not generally share the state income-tax-exemption. A detailed breakdown of tax status by state is provided in the Appendix. These differences in state tax-exempt status provide a unique opportunity to investigate the market pricing of these bonds.

Tax effects are governed by the tax code at both the Federal and state levels as investors respond to tax regulations in an attempt to maximize utility. Changes in the tax codes over time may substantially impact changes in the relative pricing of assets. Such changes may lead to alterations in the response of investors to effective tax rates and tax exemptions. It is the tax code that governs the relative tax differentials among assets. Within the context of the tax code, there are two major sources of tax effects that influence bond prices. First, there are certain tax effects that can be identified between bonds of the same issuer; i.e., tax treatment differences that result in intra-market tax effects. For example, bonds purchased at a discount may give rise to capital gains taxes if held to maturity. These are the effects such as identified by McCulloch (1975) and Jordan (1984). However, Green and Odegaard (1997) find that the tax effects associated with the estimation of the term structure effectively disappear with the Tax Reform Act of 1986. Second, the taxable status of the bond issue may lead to relative price

differences between taxable and tax-exempt securities. It is the latter concept that we address in this paper.

Yield spreads may be influenced by the tax status of the investor regardless of the tax status of the bond. If tax-exempt investors, such as pension funds, are primary investors in GSE bonds, then one would expect to find no yield differential for the benefit of the state tax exemption. The tax exemption becomes redundant to the taxable status of the investor. However, to the degree that investors are taxable, differing tax exemptions among bonds should directly impact prices if investors are concerned with after-tax cash flows. Elton et al. (2001) provide recent evidence that the relative difference in prices between the corporate bond and government bond markets is due in part to a tax premium. Severn and Stewart (1992) suggest that the spread between corporate and Treasury spreads implies a marginal state tax rate of no more than 4%.

In general, any tax-related yield differential is anticipated to reflect the combined state and local tax rate of the marginal investor. Thus, GSE bond yields should contain a tax premium relative to Treasury securities only if they are not exempt from state and local taxes.

This paper is very important for several reasons. First, according to Ambrose and King (2002), investors are increasingly substituting agency debt for U.S. Treasury debt given the sizeable decline in offerings in the Treasury debt market. This substitution of GSE bonds as benchmark securities places increased importance on understanding the pricing dynamics of this market. Second, our results provide significant insights for both the issuers and investors in GSE bonds. Our results suggest that tax incentives are available to financial institutions as they are the primary taxable investor in this market.

The remainder of this paper is organized as follows. In Section 2, we survey the state tax laws to obtain a preliminary estimate of the value of the tax benefit. In Section 3, we describe our data and methodology used in the analysis of bond pairs and triplets. Section 4 describes the methodology and discusses the empirical results of our cross-sectional analyses. Section 5 concludes and discusses the implications of our results.

2. Survey of State Tax Laws and Regulations

We research each State Tax Authority to determine whether interest on relevant GSE securities is exempt from state income taxes as provided by 12 USC 1433. The State Income Tax Exemption Guide excerpted from the 1999 U.S. Agency Handbook published by ABN AMRO was used as the authoritative source for corporations. The taxable status of each GSE by taxing authority is provided in the Appendix.

Based on our review of the current tax statutes and regulations of the fifty-four taxing jurisdictions (states, districts, and territories), we find that there is a state income tax benefit in 35 of the 54 jurisdictions. Loss of the benefit in 13 of the jurisdictions is the direct result of no state income tax at either or /both the individual or corporate levels.

Montana presents a unique situation. While their tax regulations and the Agency Handbook indicate the existence of an exemption, the filing instructions accompanying the 2000 State of Montana Income Tax Return are clearly at odds with the letter and intent of 12 USC 1433. The following instructions appear on Page 4:

Line 28 - Interest Income - received on obligations of the United States Government is exempt from Montana income tax if the following conditions are met: the instruments must be written documents, bear interest, and contain a binding promise by the United States to pay specified sums at specific dates. They must also contain specific Congressional Authorization which pledges the full faith and credit of the United States in support of the promise to pay. If any one of these

conditions is not met, the interest from the obligation is taxable to Montana. Obligations that are taxable include GNMA's and FNMA's.

Any taxpayer who might claim an exemption for interest received on tax-exempted GSE securities would most certainly be challenged by the Department of Revenue. Therefore, we assume no tax benefit exists for either individuals or corporations.

We conduct preliminary estimates of the available state income tax benefit offered by the state income tax exemption. Assuming no market imperfections and homogeneous default risk across agencies, efficient markets should produce the following relationship for par bonds:

$$Y_t [1-t_F(1-t_s)-t_s] = Y_e(1-t_F) \quad (1)$$

Where: Y_t = yield on state and local taxable GSE bonds
 Y_e = yield on state and local tax exempt GSE bonds
 t_F = Federal income tax rate for the marginal investor
 t_s = state and local tax rate for the marginal investor

This equation reflects the fact that state income tax payments are deductible for Federal income tax purposes. However, the Federal tax rate can easily be factored out of the equation as shown below. This leaves the state tax rate as the sole determinant of the benefit of state tax-exempt over non-exempt securities.

$$Y_t (1-t_F)(1-t_s) = Y_e(1-t_F) \quad (2)$$

$$Y_t (1-t_s) = Y_e \quad (3)$$

Based on this relationship and assuming the imposition of the highest marginal tax rate by a taxing jurisdiction, we are able to estimate the benefit per 1% par coupon as follows:

$$\text{Benefit per 100 basis points} = \frac{100}{1 - t_s} - 100 \quad (4)$$

The marginal tax rates and the resulting tax benefit by taxing authority are provided in Table 1. A tax benefit is available for investment in GSEs to individuals in 40 jurisdictions and to corporations in 38 jurisdictions. The greatest benefit to the investor is available in North Dakota which imposes the highest marginal tax rates at both the individual and corporate level. The marginal rate for individuals is 13.64% as compared with 11.73% for corporations. The average exemption benefit per 1% coupon over all jurisdictions where available is 5.3 basis points for individuals and 5.6 basis points for corporations. Not surprisingly, the value of the benefit tends to be slightly greater for the corporate taxpayer given the generally higher marginal tax rates imposed on corporations.

(Insert Table 1)

These estimates simply show that a benefit is available to taxable investors in state tax-exempt GSEs. A tax benefit should be traceable to bond prices to the degree that taxable investors take advantage of this benefit. We next review the empirical evidence of the value of this benefit in the marketplace.

3. Bond Pairs and Triplets

We first attempt to identify bond pairs and triplets to provide empirical evidence of the market price of the tax benefit. Using the Fixed Income Database from the University of Houston, we identify pairs and triplets from January 1987 through March 1998. This month-end bond data is filtered to exclude all bonds with embedded options and all bonds for which no trader quote is available. The data is also filtered to exclude all bonds issued before 1986 to avoid the complications associated with the different tax treatment of premium and discount bonds issued prior to this year.

The timeframe for the testing of bond pairs and triplets is limited by two constraints. First, the database is proprietary to Lehman Brothers following the repurchase of the dataset from the University of Houston in 1998. No pricing data is available on this dataset beyond this year. Second, regulatory constraints hinder our ability to identify arbitrage opportunities in the GSE markets subsequent to this period. The U.S. Treasury's Office of Public Debt negotiated a memorandum of understanding among the GSEs in 1997 governing market access. The effect of this rule has been to limit the number of large, liquid issues being priced and offered on the same day.

3.1 Bond Pairs

Rational investors would be indifferent between after-tax equivalent cash flows. Arbitrage tests depend on having two portfolios with identical cash flows. One method to create such portfolios is through the identification of bond pairs. We identify GSE bonds that share the same maturity, same coupon and same discount/premium status. The identified pairs are summarized in Table 2.

(Insert Table 2)

We are only able to identify 5 GSE bond pairs, with a total of 196 observations of month-end bid quote prices. Although it is difficult to draw any conclusions from such a small sample, there is some preliminary evidence of liquidity differences and no preliminary evidence of tax differences.

Only one bond pair provides a comparison of bonds with differing tax status. A matched pair exists between the FHLB and FHLMC that mature in December of 1996. The fact that FHLMC is taxable at the state level suggests that the FHLMC bond should be consistently priced below the FHLB bond. We estimate the mean and conduct a t-test of the hypothesis that the mean price difference is equal to zero. The mean price difference is -0.004 . The negative sign is consistent with our expectations, but it is not statistically significant at the 5% level of significance.

Bonds of the same agency represent 3 of the 5 pairs. If a bond pair reflects the bonds of the same agency, then the bonds should have identical prices in the absence of market frictions. In this case, we test to see whether the mean difference in price is statistically different from zero across each pair. There should be no difference in pricing unless the market prices by size since this is the only remaining difference in the paired bonds. The first two pairs reflect no pricing differences in bonds of the same agency. The third pair is a FHLB strip for which there is a long time series of data consistently reflects a pricing difference. The bonds have the identical issuer, coupon and maturity date and are free of embedded options. There are two possible explanations for this difference in pricing. First, using information internal to the FHLB, we are able

to identify Cusip #31339KBF is an interest only security (I/O) whereas Cusip #31339KBG is a principal only security (P/O). The pricing of the two securities will generally tend to move in opposite directions and differ based on the interest rate environment. The period in question was a declining rate environment in general as reflected in Figure 1. Short-term rates were increasing for the first few years with long-term rates declining which led to a flattening of the yield curve over this period.

(Insert Figure 1)

3.2 Bond Triplets

An alternative method for creating after-tax equivalent portfolios is through the identification of bond triplets. A bond triplet is defined as a set of three bonds with the same maturity date but with different coupon rates. We follow Jordan and Jordan (1991) in the replication of pretax cash flows for bond triplets.

The tax consequences for purchases of originally-issued discount bonds are straightforward. Bonds originally issued at a discount from par require the amortization of the discount by the constant yield method. The amortized discount is ordinary income to the investor in each taxable period.

The tax treatment of coupon bonds not trading at par is more complicated. Substantial asymmetries existed in the tax treatments of coupon-bearing bonds trading at a discount versus trading at a premium prior to the Tax Reform Act of 1986. Although the Tax Reform Act served to eliminate several advantages to holding discount bonds,

tax-timing issues still remain. The tax consequences for coupon-bearing bonds that are not trading at par involve both coupon payments and the difference in the market price from par. Coupon payments are taxed when received at the ordinary income tax rate regardless of the price of the bond. In contrast, any differences in price from par introduce potential tax-timing considerations. Any tax liability arising from the gain from the discount from par can be deferred to maturity or disposition of the bond whereas the premium is amortized over the bond's remaining life by the constant yield method. For tax years beginning in 1987, taxes are based on the regular income tax rate for both discount and premiums. Discounts from par are taxed as a gain at the regular income tax rate at maturity or disposition. Premiums above par are amortized as deductions from regular income for tax purposes. The constant yield method of amortization is required of all coupon-bearing bonds issued subsequent to September 27, 1985. Thus, tax-timing considerations remain subsequent to the Tax Reform Act of 1986.

Remaining tax-timing considerations between premium and discount bonds requires that we limit our sub-samples of triplets to pure premiums or pure discount bonds. By developing triplets of pure premium bonds or pure discount bonds, the tax consequences should be the same across bonds. In addition, we limit the sample to bonds issued subsequent to September 27, 1985.

Our results are provided in Table 3. Our bond triplets provide very little additional information. Given the extensive limitations required, our sample is ultimately limited to 28 observations of bond triplets. The inside and outside bonds used to form the triplets represent bonds of different government sponsored entities. We obtain no statistically significant results at the 95% confidence interval in the pricing, regardless of whether that

bond triplet is formed using similar or dissimilar taxable-status bonds. This would suggest that the market prices GSE bonds as a homogeneous pool. However, the sample is much too small to draw any substantive conclusions.

(Insert Table 3)

4. GSE Spreads Over Same Maturity Treasuries

An alternative way to analyze the pricing between GSE bonds is through their relationship to Treasury securities of the same maturity. Again using the Fixed Income Database from the University of Houston, we analyze the yield spreads between GSE bonds and Treasury securities with identical maturities. We use a dummy variable approach in the measurement of the tax effect in cross-sectional regressions. The data includes 687 observations of month-end bid quotes of non-callable GSE bonds. The time period of the cross section is January 1992 through March 1998. We perform a cross-sectional analysis of all monthly bond quotes across all GSEs. We also run restricted and unrestricted regressions to analyze whether there is a structural break in the data between state-taxable bonds and non-state-taxable bonds.

The dependent variable in our cross-sectional regressions is yield spread. This spread is measured as the difference in the yield to maturity of a GSE bond and an identical maturity Treasury security.

We identify variables from the previous literature that are important in the determination of bond spreads. The spread between GSE bonds and Treasury bonds

would be expected to include risk premiums for default risk, liquidity risk and tax differences. Elton et. al. (2001) also provide evidence that there is a premium for market risk in bond spreads. As all of these risk premiums affect GSE bond prices, we incorporate variables that provide insight into all of these different risk premiums. We describe each further below.

In general, we do not attempt to capture differences in the default risk between government sponsored entities. All GSEs enjoy the highest credit rating as assigned by Moody's and/or Standard and Poor's. This is based to some degree on their implicit government backing. We would expect that any difference between GSEs would not represent differences in credit quality of the issuer but rather perceived differences in the issue. However, the one caveat to this is the fact that, of the four GSEs for which we have data, there is a substantial difference in ownership. The equity of Fannie Mae and Freddie Mac are publicly traded. Both the Federal Home Loan Banks and the Federal Farm Credit Banks are cooperatives and are owned by their members. The market may charge a premium for the increased asymmetry of information for the GSEs that are privately held. Because the bond issues of the two privately-held GSEs also share the same tax status, we have incorporated a market risk measure in an attempt to differentiate between market risk and tax issues. We use monthly changes in the NYSE Financial Index to measure market risk.

Variation in risk premiums over time is well documented within the literature. For example, Priestley (2001) finds that news effects asset prices more at times of high risk than at times of low risk. Niendorf and Ottaway (2002) suggest that different risk preferences under different market conditions may lead to time variation in market risk

premiums. The time frame of our sample (1/92 – 3/98) covers a period of declining interest rates and a very strong, robust economy.

We establish three liquidity proxies, both of which have been identified in the literature. Consistent with Sarig and Warga (1989) and Warga (1992), we use age as a proxy for liquidity. Crabbe and Turner (1995) analyze whether issue size provides a measure of liquidity. We also add a variable for the size of the GSE bond issue relative to the size of the identical maturity Treasury security. Since the same maturity Treasury security serves as the benchmark, the ratio should provide the liquidity adjustment to the issue relative to the liquidity of the Treasury security.

Tax status is measured using a dummy variable approach. The bonds of the FHLBanks and the Federal Farm Credit Banks are assigned a zero given that these bonds are generally exempt from state taxation. The Fannie Mae and Freddie Mac bonds are identified with a one given that the bonds are taxable at the state level.

We anticipate that there will be a coupon effect in the yield spread that we measure as the difference of the GSE bond coupon less the Treasury coupon rate. Lower coupon bonds should have a larger rate adjustment. However, it must be noted that the Treasury bond will not necessarily have the lower coupon, as the dates of issuance of the Treasury and GSE are not the same.

As noted previously, there are still possible tax timing advantages to the investor from the purchase of discount versus premium bonds. This is due to the fact that the recording of the gain on the discount bond can be deferred to maturity or disposition for a cash-basis taxpayer. Thus, we incorporate the amount of the discount or premium as a variable to capture possible differences.

Several term structure variables have been identified as significant in the variation of yield spreads between Treasury securities and corporate bonds. For example, Duffee (1998) examines the variation in corporate yield spreads with changes in the level and slope of the Treasury term structure. Longstaff and Schwartz (1995) measure the effect of changes in the yield of Treasury securities on corporate credit spreads. We use these same term structure variables of level and change to measure the impact of the same on yield spreads in the GSE markets. Level is proxied using the yield to maturity of the identical maturity Treasury security. Change is measured as the change in the yield to maturity between time $t+1$ and t . In addition, the bond term in years is incorporated to capture the term variation in credit spreads such as that documented by Litterman and Iben (1991).

We run the following cross-sectional regressions using the variables described above.

$$S = c + TD + T + A + IS + RS + CD + DP + TY + CTY + Term + FI \quad (5)$$

Where: c = constant

TD: Tax Dummy

T = Time Trend

A = Bond age

IS = Issue Size

RS = Issue Size relative to same maturity Treasury

CD = Coupon difference; GSE bond coupon rate less Treasury coupon rate

DP = Amount of discount or premium

TY = Treasury yield to maturity

$$CTY = TY_t - TY_{t-1}$$

Term = Bond remaining term to maturity measured in years

FI = Monthly change in the New York Stock Exchange Financial Index

A. Empirical Results

We use month-end bond spreads over the same maturity Treasury securities to analyze a cross section of GSE bonds trading in the over-the counter-market (“OTC”). The cross section of 687 bonds is distributed unevenly across GSEs. The number of observations is heavily weighted toward the FHLBank bonds which account for 54% of the observations. This weighting reflects a major practice difference between agencies. Whereas the other agencies maintain a proscribed funding schedule, the FHLBank's Office of Finance issues bonds based on the specific demand needs of member banks. Therefore, there tends to be a larger number of outstanding FHLBank bonds but of a smaller issuance size relative to the other GSEs. A summary of bond spreads by GSE is provided in Figure 2. Within the sample, Fannie Mae bonds exhibit the highest spread over Treasuries on average. However, this does not take into account the specific characteristics of the cross section that lead to such differences.

(Insert Figure 2)

In Table 4 we present summary statistics pertaining to the characteristics of bonds traded by each GSE and the pooled sample. The average yield spread over Treasuries

for the entire sample is 21 basis points. For the most part, the sample includes short-term bonds with an average age of approximately 2 years.

(Insert Table 4)

We find that there is a significant difference between the spreads associated with non-state-taxable and state-taxable bonds. The results of our cross-sectional regressions are provided in Table 5. We present the results using the pooled data of all bonds as well as the results of the regressions using sub-samples based on bond tax status.

(Insert Table 5)

The pooled regression restricts all bonds across GSEs to the same coefficients with the exception of the constant term. This assumes that the market treats GSE bonds as a homogeneous pool and that investors make a simple upward adjustment in spread to account for the tax differences. We are able to explain a relatively high variation in spread relative to previous studies of bond spreads over Treasuries. We obtain an adjusted R^2 of 34% which is much greater than results typically obtained with spread regressions. This, in part, reflects a more homogeneous pool of bonds than those using a cross-section of corporate bonds. In addition, it reflects the exact matching of maturities with the Treasury securities.

Although the coefficient on tax status is significant, it is of the wrong sign. With an additional tax burden to the investor, there should be an increase in the spread to eliminate tax arbitrage opportunities. Thus, it appears that the market does not value the tax benefit. We believe that this reflects the fact that the marginal investor of these bonds is tax exempt. It must be also noted that the coefficient on tax status is significant both statistically and economically. The estimate reflects a reduction of 8 basis points in spread for Freddie Mac and Fannie Mae bonds over non-state-taxable GSEs. We would argue that this reflects the perceived reduction in risk to these bonds given publicly-available information. It is the only remaining distinguishing characteristic across the GSEs once the tax status is eliminated from consideration. Although the negative sign on the tax dummy variable indicates that the market is pricing the risk premium associated with the asymmetry of information, it is not possible to measure the magnitude given the potential impact of the tax consideration.

We conduct further tests to evaluate whether the pricing model is the same regardless of the tax status of the bond. We conduct Chow Tests to test the null hypothesis that the coefficient vectors are the same across state-taxable and non-state-taxable bonds. As noted by Greene (1995), the test is valid whether or not the disturbance variances are the same across restricted regressions given the relatively large sample size. We compute an $F(10,20)$ statistic of 12.73 based on the residual sum of squares from the restricted and unrestricted regressions. Therefore, we reject the null hypothesis of common coefficients at the 1% level of significance.

The unrestricted tax status regressions provide an adjusted R^2 of 38% for the state-taxable bonds relative to a 43% for the non-state-taxable bonds. It appears that the

market is pricing Freddie Mac and Fannie Mae more favorably than the bonds of the Federal Home Loan Banks or the Federal Farm Credit Banks.

As would be expected, the time trend variable which measures the distance from the earliest dated observation is both statistically and economically significant. The coefficient is positive which indicates that spreads were increasing over time. As would be expected in light of informational asymmetries, the increase is greater for state-tax-exempt GSE bonds. In addition, the most significant event in the bond markets during this period was the Asian Crisis that affected bond pricing from 1997 through 1998. Although one would expect that the investors' overall flight to quality would reduce spreads in the Aaa market relative to Treasuries, it appears that the result was a general increase in spreads across all credit qualities.

The variables designed to capture liquidity are only moderately successful. Age and issue size are not economically significant for either type of GSE bond. In addition, given that we are using month-end bid quotes, it is likely that our measures of liquidity are incapable of picking up this effect. The relative size variable is more successful, but provides results that are difficult to reconcile. State-taxable bond yield spreads decrease with relative size whereas non-state-taxable bond yield spreads increase with relative size. In effect, the market appears to be imposing a premium on those issues and issuers that are beyond that issuer's typical business practice. For example, the bonds of the FHLBanks tend to be smaller in size than those of other GSEs. If the FHLBanks were to issue relatively large, long-term securities, currently the province of Fannie Mae and Freddie Mac, the market appears to impose a premium on such a FHLBank issues. Such issues will likely trade differently in the secondary market since there are not other "like"

securities against which performance might be evaluated. Confirmation of this observation is beyond the scope of this paper and awaits further study.

The coupon variable effectively captures the impact of the coupon difference of the Treasury and GSE bond. The coefficient is not statistically significant for non-state-taxable bonds as compared with a coefficient of 0.04 for state-taxable bonds that is significant at the 5% level. As noted previously, it is not possible to sign the coefficient since the paired bonds are issued on different dates.

The discount/premium variable is only significant for the FHLB/FFCB bonds. The sign is negative which is consistent with a reduction in spread for the favorable treatment of discount bonds; i.e., the deferral of the tax consequences.

Yield curve variables are significant in general. Consistent with the findings of Duffee(1998) and Longstaff and Schwartz (1995), we find a negative relationship between credit spreads and the change in the yield to maturity of Treasury securities. The negative sign on the non-state-taxable bonds may indicate that the larger up-front premium charged on these bonds is mitigated as the level of rates increases.

The largest economic impact for non-state-taxable bonds is affected by the term variable with a coefficient of 0.11. The coefficient on state-taxable bonds is also statistically significant but not as large. Although the identical maturity Treasury will also have a yield component for term, finding an additional premium for term is consistent with the term structure of credit spreads.

Although we included a market variable, we did not find the estimated coefficient to be statistically significant in any regression. This might reflect the quasi government guarantee associated with these bonds. As we postulate in a preceding section of this

paper and observe in the marketplace, GSE securities do trade as a class by similar maturity and structure.

Given that our results indicate different pricing between tax-exempt and taxable bonds, it is possible that investors develop more complex models across individual GSE bonds. Although we do not present the results here, we conduct further tests for structural breaks across the individual GSEs. We run restricted regressions by tax status incorporating a dummy variable for the individual GSE. For example, we run a restricted regression of state-taxable bonds with a dummy variable having a value of 0 if it is a FHLMC bond and 1 if it is a FNMA bond. In order to perform the Chow test, we run restricted regressions of each GSE. We find no evidence of differences in pricing across common tax status GSE bonds.

5. Conclusions and Discussion

A tax benefit is available to taxable investors from the purchase of GSE bonds that carry a tax exemption at the state and local levels. The benefit to the typical individual investor is estimated to be 5.74 basis points for each 100 basis points of coupon rate. For the typical corporate investor, that value is estimated at 6.09 basis points. However, our results indicate that this benefit is not priced by the market. We suggest that this result may be due to the redundancy of the exemption for the marginal investor; i.e., that tax exempt investors such as pension funds are primary purchasers of GSE bonds. Our findings suggest that taxable investors will find an advantage in the market pricing of the bonds of the Federal Home Loan Banks and the Federal Farm Credit Banks.

We also provide preliminary evidence of segmentation in the GSE markets. Our results suggest that there are significant differences in bond pricing across GSEs. Fannie Mae and Freddie Mac have voluntarily provided much of the financial information required by the SEC as related to its equities. Only this month, the two GSEs have agreed to meet the financial disclosure requirements of the SEC regarding its equities, but the debt securities of both remain exempt from the registration requirements of the Securities Act of 1933. Therefore, potential asymmetry of information between the bond markets and the GSEs remains. Yet the market does not adjust for the taxation differences between GSE bonds. We believe that this is due to the fact that the marginal investor is tax-exempt which makes the exemption redundant. Furthermore, it suggests that there is an advantage to purchasing these bonds by the tax exempt investor.

References

- Ambrose, B. W. and T. D. King, 2002, GSE Debt and the decline in the Treasury debt market, *Journal of Money, Credit, and Banking* 34, 812-839.
- Crabbe, L. E. and C. M. Turner, 1995, Does the liquidity of a debt issue increase with its size? Evidence from the corporate bond and medium-term note markets, *Journal of Finance* 50, 1719-1734.
- Duffee, G. R., 1998. The relation between Treasury yields and corporate bond yield spreads, *Journal of Finance* 53, 2225-2241.
- Elton, E. J. and T. C. Green, 1998. Tax and liquidity effects in pricing government bonds, *Journal of Finance* 53, 1533-1562.
- Elton, E. J., M. J. Gruber, D. Agrawal, and C. Mann, 2001. Explaining the rate spread on corporate bonds, *Journal of Finance* 56, 247-277.
- Green, R. C. and B. A. Odegaard, 1997. Are there tax effects in the relative pricing of U.S. government bonds, *Journal of Finance* 52, 609-633.
- Greene, W. H., 2000. *Econometric Analysis*. (Prentice-Hall, Upper Saddle River, New Jersey)
- Jordan, J. V., 1984. Tax effects in term structure estimation, *Journal of Finance* 34, 393-106.
- Jordan, B. D. and S.D. Jordan, 1991. Tax options and the pricing of Treasury bond triplets, *Journal of Financial Economics* 30, 135-164.
- Leonard, P. A., 1998. Tax-induced segmentation in the tax exempt securities market, *Quarterly Journal of Business Economics* 37, 27-47.

- Litterman, R. and T. Iben, 1991. Corporate bond valuation and the term structure of credit spreads, *Journal of Portfolio Management*, 52-64.
- Longstaff, F. A. and E. S. Schwartz, 1995. A simple approach to valuing risky fixed and floating rate debt, *The Journal of Finance* 50, 789-829.
- McCulloch, J. H., 1975. The tax-adjusted yield curve, *Journal of Finance* 30, 811-830.
- Niendorf, B. and T. Ottaway, 2002. Wealth effects of time variation in investor risk preferences, *Journal of Economics and Finance* 26, 77-87.
- Priestley, R., 2001. Time-varying persistence in expected returns, *Journal of Banking and Finance* 25, 1271-1286.
- Sarig, O. and A. Warga, 1989. Bond price data and bond market liquidity, *Journal of Financial and Quantitative Analysis* 24, 367-378.
- Severn, A. K. and W. J. Stewart, 1992. The corporate-treasury yield spread and state taxes, *Journal of Economics and Business* 40, 161-166.
- Warga, A., 1992. Bond returns, liquidity, and missing data, *Journal of Financial and Quantitative Analysis* 27, 605-617.

Appendix

State Tax Exemption Guide

The following table contains a general list of the tax status of agency-issued securities in each state and should be used for reference purposes only. For specific details regarding the tax status of agency-issued bonds for your institution, please contact the appropriate state department of revenue or tax department.

State	FHLB	FFCB	SLMA	FHLMC	TVA	PEFCO	EXIM	GNMA	FNMA
Alabama	E	E	T	T	E	T	T	T	T
Alaska	E	E	T	T	T	T	T	T	T
Arizona	E	E	E	T	E	T	T	T	T
Arkansas	E	E	E	T	E	T	T	T	T
California ¹	T	T	T	T	T	T	T	T	T
Colorado	E	E	E	T	E	T	T	T	T
Connecticut	E	E	E ²	T	E	T	T	T	T
Delaware ³	E	E	E	T	E	T	T	T	T
Florida ⁴	E	E	E	T	E	E	E	E	T
Georgia	E	E	E	E	E	E	E	T	T
Hawaii	E	T	E	T	E	T	T ⁵	T	T
Idaho	E	E	E	T	E	T	T	T	T
Illinois	E	E	E	T	E	T	T	T	T
Nebraska	E	E	E	T	E	T	E	T	T
Nevada	E	E	E	E	E	E	E	E	E
New Hampshire	E	E	E	T	E	T	T	T	T
New Jersey	E	E	E	T	E	T	T ⁶	T	T
New Mexico	E	E	E	T	E	T	E	T	T
New York	E	E	E	T	E	T	T ⁷	T	T
North Carolina	E	E	E	T	E	T	E	T	T
North Dakota	E	E	E	T	E	T	E	E	E
Ohio	E	E	E	T	E	T	T	T	T
Oklahoma ⁸	E	E	E	E	E	T	T	T	T
Oregon	E	E	E	T	E	T	T ⁹	T ¹⁰	T
Pennsylvania	E	E	T	E	T	T	T	T	T
Indiana	E	E	E	T	E	T	E	T	T

¹ Banks doing business in California and corporations doing business, incorporated or qualified in are subject to a franchise tax. See Section 24272 of California Revenue and Taxation Code at www.leginfo.ca.gov

² Obligations issued by SLMA are exempt. Obligation guaranteed, but not issued by SLMA are not exempt.

³ Technical information memo

⁴ Exempt from intangible tax only in state of Florida

⁵ Interest on Series 1978-B debentures is exempt from taxation. Participation certificates (reversal of Counsel opinion dated 8/29/67) are taxable in Hawaii

⁶ Interest on Series 1978-B debentures is exempt from taxation. Participation certificates are taxable in New Jersey

⁷ Interest on Series 1978-B debentures is exempt from taxation. Participation certificates are taxable in New York

⁸ Excludes the interest income, but then reduce the expense by 50% (i.e. ½ of the interest is state tax exempt in Oklahoma)

⁹ If the creditor has defaulted and EXIM is paying the interest it is nontaxable

¹⁰ If the creditor has defaulted and EXIM is paying the interest it is nontaxable

Iowa ¹¹	T	T	T	T	T	T	T	T	T
Kansas	E	E	E	T	E	T	T	T	T
Kentucky ¹²	E	E	E	T	E	T	T	T	T
Maine	E	E	E	T	E	T	T	T	T
Maryland	E	E	E	T	E	T	T	T	T
Massachusetts ¹³	T	T	T	T	T	T	T	T	T
Michigan ¹⁴	E	E	E	T	E	T	T	T	T
Minnesota ¹⁵	T	T	T	T	T	T	T	T	T
Mississippi	E	E	T	T	E	T	E	T	T
Missouri	E	E	E	T	E	T	T	T	T
Montana ¹⁶	T	T	T	T	T	T	T	T	T
Rhode Island	E	E	T	T	E	T	T	T	T ¹⁷
South Carolina	T	T	T	T	T	T	T	T	T
South Dakota ¹⁸	T	T	T	T	T	T	T	T	T
Tennessee	E	T	E ¹⁹	T	E	T	T	T	T
Texas	E	E	E	T	T	T	T	T	T
Vermont	E	E	E	T	E	T	T	T	T
Virginia	E	E	E	T	E	T	E	T	T
Washington ²⁰	E	*	*	T	*	*	E	E	T
West Virginia	E	E	E	E	E	T	T	E	E
Wisconsin	T	T	T	T	T	T	T	T	T
Wyoming	E	E	E	E	E	E	E	E	E

¹¹ All interest on agency-issued bonds is taxable income for franchise tax purposes

¹² Circular 40C003

¹³ Corporate Excise Tax: Chapter 63, Section 30, Subsection: Definition of gross income

¹⁴ Revenue Administration Bulletin 1989-10

¹⁵ Franchise tax. Section 290.0 Income Tax Division

¹⁶ Franchise Tax

¹⁷ Guaranteed Participation Certificates are tax exempt; and bonds and debentures are taxable in Rhode Island

¹⁸ Franchise Tax

¹⁹ Interest on Sallie Mae is exempt from taxation. Income received from dividend payments, however, is taxable

²⁰ Business and Occupation tax. Published rule 146. Only interest on direct obligations, agencies, or instrumentalities of the federal government is exempt. Interest attributable to loans or other financial obligations on which the government is merely a guarantor or insurer is not exempt. The department of revenue in Washington has not ruled on the agencies with * at this time

Table I.
Marginal Tax Rates and Estimated Tax Benefits

Panel A: Maximum Applicable Tax Rates by Taxing Authority

The highest marginal tax rate for each taxing authority is presented below. No entry is shown below for those jurisdictions that impose no tax. In addition, there are several instances in which the jurisdiction imposes a tax but does not pass the benefit through to the investor. To the extent that there is no available tax benefit, the tax rate is shown in bold italics.

	Indiv	Corp		Indiv	Corp		Indiv	Corp
Alabama	5.00	5.00	Kentucky	6.00	8.25	Ohio	6.98	8.50
Alaska	-	9.40	Louisiana	6.00	8.00	Oklahoma	6.75	6.00
Arizona	5.04	6.97	Maine	8.50	8.93	Oregon	9.00	6.60
Arkansas	7.00	6.50	Maryland	4.75	7.00	Pennsylvania	2.80	9.99
California	9.30	8.84	Massachusetts	5.60	9.50	Puerto Rico	-	-
Colorado	4.63	4.63	Michigan	4.20	-	Rhode Island	10.10	9.00
Connecticut	4.50	7.50	Minnesota	7.85	9.80	South Carolina	7.00	5.00
District of Columbia	9.00	9.98	Mississippi	5.00	5.00	South Dakota	-	-
Delaware	5.95	8.70	Missouri	6.00	6.25	Tennessee	-	6.00
Florida	-	5.50	Montana	11.00	6.75	Texas	-	-
Georgia	6.00	6.00	Nebraska	6.68	7.81	Utah	7.00	5.00
Guam	-	-	Nevada	-	-	Vermont	9.50	9.75
Hawaii	8.50	6.40	New Hampshire	-	8.00	Virgin Islands	-	-
Idaho	8.20	8.00	New Jersey	6.37	9.00	Virginia	5.75	6.00
Illinois	3.00	7.30	New Mexico	8.20	7.60	Washington	-	-
Indiana	3.40	7.90	New York	6.85	8.00	West Virginia	6.50	9.00
Iowa	8.98	12.00	North Carolina	7.75	6.90	Wisconsin	6.75	7.90
Kansas	6.45	4.00	North Dakota	12.00	10.50	Wyoming	-	-

Panel B: Estimated Tax Benefit in Basis Points Per 1% Coupon

To the extent that a tax benefit is available, the benefit is calculated per 1% par coupon. The benefit is estimated as $100bp/(1-t_s) - 100bp$. If no tax benefit is available in the taxing jurisdiction, there is no entry for a benefit in the table below.

	Indiv	Corp		Indiv	Corp		Indiv	Corp
Alabama	5.26	5.26	Kentucky	6.38	8.99	Ohio	7.50	9.29
Alaska	-	10.38	Louisiana	6.38	8.70	Oklahoma	7.24	6.38
Arizona	5.31	7.49	Maine	9.29	9.81	Oregon	9.89	7.07
Arkansas	7.53	6.95	Maryland	4.99	7.53	Pennsylvania	2.88	11.10
California	10.25	-	Massachusetts	5.93	-	Puerto Rico	-	-
Colorado	4.85	4.85	Michigan	4.38	-	Rhode Island	11.23	9.89
Connecticut	4.71	8.11	Minnesota	8.52	-	South Carolina	7.53	-
District of Columbia	9.89	11.09	Mississippi	5.26	5.26	South Dakota	-	-
Delaware	6.33	9.53	Missouri	6.38	6.67	Tennessee	-	6.38
Florida	-	5.82	Montana	-	-	Texas	-	-
Georgia	6.38	6.38	Nebraska	7.16	8.47	Utah	7.53	5.26
Guam	-	-	Nevada	-	-	Vermont	10.50	10.80
Hawaii	9.29	6.84	New Hampshire	-	8.70	Virgin Islands	-	-
Idaho	8.93	8.70	New Jersey	6.80	9.89	Virginia	6.10	6.38
Illinois	3.09	7.87	New Mexico	8.93	8.23	Washington	-	-
Indiana	3.52	8.58	New York	7.35	8.70	West Virginia	6.95	9.89
Iowa	-	-	North Carolina	8.40	7.41	Wisconsin	7.24	-
Kansas	6.89	4.17	North Dakota	13.64	11.73	Wyoming	-	-

Table 2

Summary of Paired Bonds

GSE Bonds with the same coupon, maturing on the same date are identified as pairs. If trader quotes are available for each bond AND both bonds are either premium or discount bonds (based on flat price), the price difference between the two bonds is calculated. This price includes accrued interest, if any. The mean difference in price for each pair is presented below. The student t-stat is provided for a test of the null hypothesis that the mean is equal to zero. The p-value is based on the 5% level of significance with n-1 degrees of freedom.

GSE	Paired GSE	Coupon			Total # Obs.	Discount	Premium
		Maturity	Rate				
FNMA 313586DQ	FNMA 313586WV	3/10/92	7.00%		53	39	14
				Mean	-0.027943	-0.036359	-0.0045
				Std Dev	0.187057	0.217966	0.016837
				t-stat	-1.09	-1.04	-1.00
				p-value	0.279	0.301	0.327
FHLB 313388RR	FHLB 313388XH	5/26/92	8.60%		19	0	19
				Mean	-0.016253		-0.016253
				Std Dev	0.039245		0.039245
				t-stat	-1.81		-1.81
				p-value	0.079		0.079
FHLB 313390Q4	FHLMC 313400Y5	12/16/96	8.69%		18	0	18
				Mean	-0.004111		-0.004111
				Std Dev	0.009499		0.009499
				t-stat	-1.84		-1.84
				p-value	0.075		0.075
FHLMC 3134A0KA	FNMA 31364BKD	9/7/00	6.24%		9	7	2
				Mean	0.001667	-0.022857	0.0875
				Std Dev	0.099753	0.100549	0.000707
				t-stat	0.05	-0.60	175.00
				p-value	0.96	0.559	0.000
FHLB 31339KBF	FHLB 31339KBG	2/25/04	0.00%		97	97	0
				Mean	0.076742	0.076742	
				Std Dev	0.121954	0.121954	
				t-stat	6.20	6.20	
				p-value	0.000	0.000	

Table 3

Summary of GSE Bond Triplets

Bond triplets comprise of state taxable and non-state taxable bonds of GSEs are compiled. Triplets are identified to the extent that trader quotes are available for all bonds in the triplet. Given limited data availability, triplets are not limited to pure discount or pure premium combinations. However, no bond within any triplet is issued prior to 1986. Bonds with less than one month to maturity are eliminated. It composition of the triplet is provided; i.e., listed below is the inside issuer as well as the outside bonds issuer. We measure the mean difference between the dirty price of the inside bond less the mean difference of the average dirty price of the outside bonds. This mean difference is not statistically different from zero at the 5% level of significance for any triplet.

Triplet #	Maturity	Coupon Rates within Triplet		
		C1	C2	C3
1	7/1/96	5.29	5.59	5.60
2	3/6/06	6.25	6.28	7.00
3	6/3/96	5.52	6.015	6.07
4	1/27/97	7.675	7.68	7.75

Triplet #	# Obs.	# of Discount	# of Premium	Inside GSE	Outside GSE
1	3	0	3	FNMA	FFCB
2	1	1	0	FHLMC	FHLB
3	5	0	5	FHLB	FFCB
4	19	0	19	FNMA	FHLMC
Total	28				

Triplet #	Mean Difference	Std. Deviation	t-stat
1	0.0137	0.0208	1.3161
2	-0.0562	N/A	
3	0.0443	0.1066	1.0195
4	0.0062	0.0142	1.9114

Table 4

Summary of GSE Bond Sample

The average and standard deviation of our variables is provided below. The sample consists of 687 observations of month-end bond data drawn from the Fixed Income Database from the University of Houston. The cross section is drawn from GSE bonds for which the data for an identical maturity Treasury security is available. The number of observations varies by GSE with 55%, 14%, 19% and 12% being accounted for by bonds of FHLB, FFCB, FHLMC and FNMA, respectively.

VARIABLE	MEAN	STANDARD DEVIATION
DEPENDENT:		
Spread	0.21	0.19
INDEPENDENT:		
Age	2.27	2.83
Coupon Difference	1.42	3.68
Treasury Yield to Maturity	5.42	0.81
Term in Years	1.31	1.36
Discount/Premium Amt.	0.23	2.21
Change in Treasury YTM	-0.04	0.33
Issue Size in Millions	265.22	392.58
Size/(Treasury Size) in %	1.51	1.44
NYSE Fin. Index %MoChg	2.03	3.59

Table 5

Summary of Cross Sectional Regressions

The results of the cross-sectional regressions are presented below. A restricted regression using the pooled data of all bonds is run assuming the same coefficients across GSEs but different intercepts. A dummy variable is used with the tax dummy equal to 0 if the bond is not state-taxable and 1 if the bond is state-taxable. Two unrestricted regressions are run allowing the coefficients across tax status to vary.

*Significant at the 5% level of significance.

	POOLED	NON STATE- TAXABLE BONDS	STATE TAXABLE BONDS
No. of Observations	687	469	218
Adjusted R²	0.34	0.43	0.38
F Statistic	44.81	36.53	14.03
Std. Error of Est.	0.15	0.15	0.12
<u>Coefficients:</u>			
Intercept	0.12*	0.18*	-0.17
Tax Status	-0.08*	N/A	N/A
Time Trend	0.04*	0.06*	0.03*
Age	0.01*	-0.00	0.00
Issue Size	-0.00*	0.00	0.00*
Size/TSize in %	0.00	0.02*	-0.04*
Cpn. Difference	0.02*	-0.00	0.04*
Disc./Premium	-0.02*	-0.02*	0.00
Treasury YTM	-0.03*	-0.06*	0.02
Chg. Treasury YTM	-0.08*	-0.08*	-0.12*
Term in Yrs	0.09*	0.11*	0.04*
NYSE Fin. Index	0.00	0.00	0.00

Average Monthly Yields of Constant Maturity Treasuries Jan'92 - Mar '98

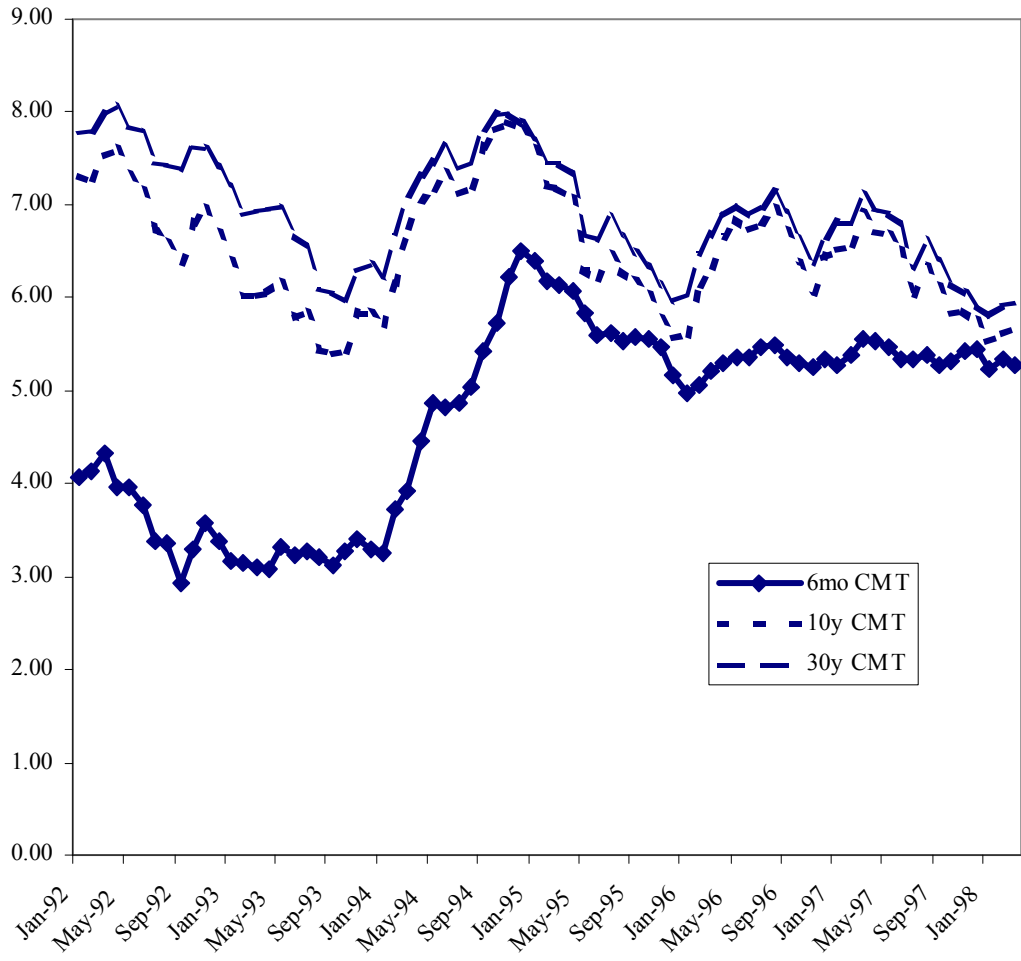


Figure 1.

Box & Whisker Plot of Spread by GSE

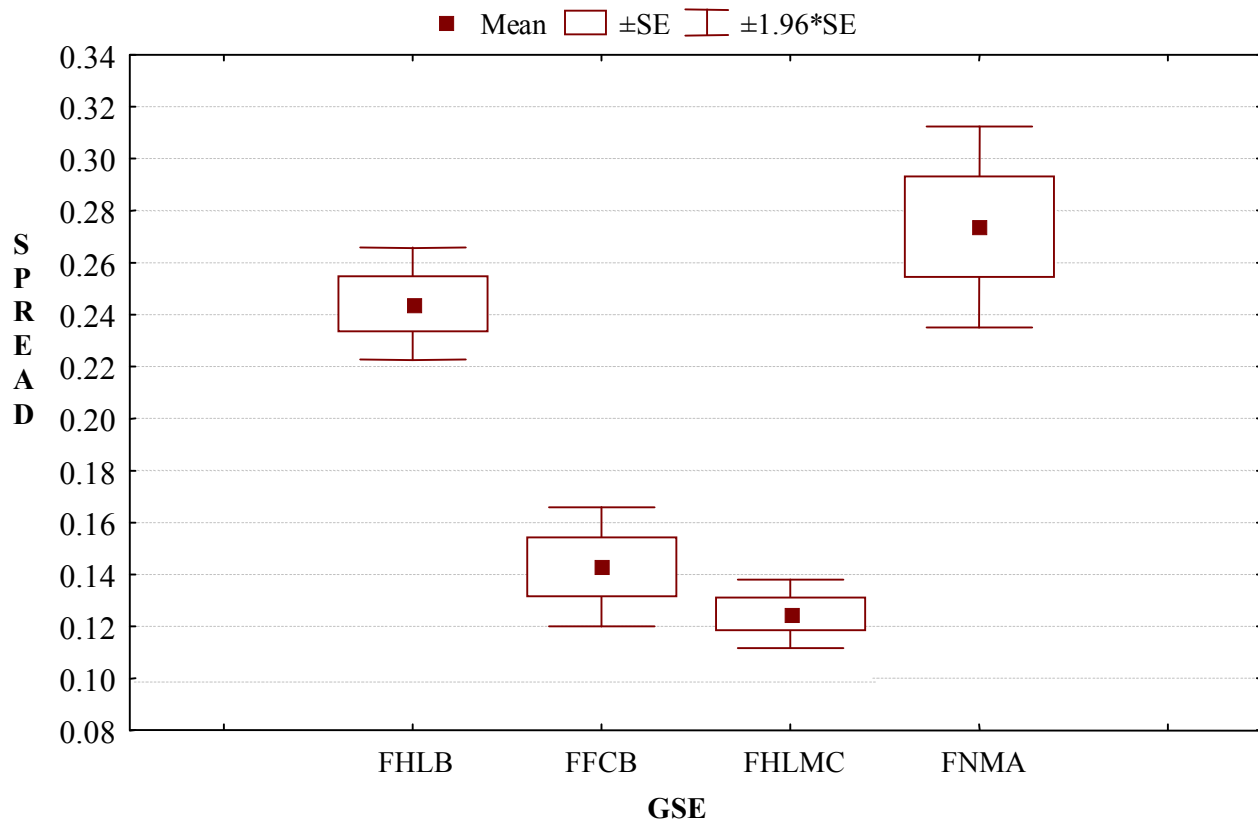


Figure 2

Box and Whisker Plot of Spread by GSE

Spread is defined as the difference between yield to maturity of a GSE bond less the yield to maturity of an identical maturity Treasury security. Basic descriptive statistics of mean and standard error are provided of the sample spread data for each GSE separately.