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TAXES, LIQUIDITY RISK, AND CREDIT SPREADS: EVIDENCE FROM THE GERMAN BOND MARKET

Introduction

Over the past decade, the European bond market has been on a path of dynamic growth. Starting from 5602 billion EUR in July 1999 the amounts outstanding of debt securities issued by Euro area residents totalled to 11810 billion EUR in July 2007[1]. Because of this impressive development, market participants show an increasing interest in understanding the factors that determine the prices of European bonds. Unfortunately, most previous studies concentrate on the U.S. market[2]. The results of these studies cannot be simply transferred to the European market. This is primarily due to different laws and regulations in the European and U.S. market. Furthermore, the markets in the Euro area are at a different stage of development and therefore show different characteristics than the mature U.S. market.

Among the member states of the European Union that have adopted the Euro as their currency, Germany features the largest bond market. This market can be regarded as a benchmark market which is of a particular interest to many investors. Behind the U.S. and Japanese market, it also captures the third-largest share of the international bond market. Though at first sight it seems to be clear that the prevalent interest level and the individual default risk of the obligors affect bond prices, the influence of other factors is rather unclear especially in the German market. Only few studies analyze the European market after the introduction of the Euro in 1999: Boss and Scheicher analyze which factors influence the first differences of credit spreads in the Euro area. They evaluate three series, namely the yield distance for Industrials, Financials, and for plain vanilla interest rate swaps, and find that beside other factors, proxies for liquidity risk are significant factors[3]. Houweling et al. consider nine different proxies to measure corporate bond liquidity in the Euro area[4].

[1] See „Euro Area Issues Statistics", ECB, July 2007 and December 1998 to July 1999.

[2] See for example L. Fisher: *Determinants of Risk Premiums on Corporate Bonds*. "Journal of Political Economy" 1959, Vol. 67, pp. 217-237; O. Sarig, A. Warga: *Some Empirical Estimates of the Risk Structure of Interest Rates.* "Journal of Finance" 1989, Vol. 44, pp. 1351-1360; Y. Amihud, H. Mendelson: *Liquidity, Maturity, and the Yields on U.S. Treasury Securities.* "Journal of Finance" 1991, Vol. 46, pp. 1411-1425; A. Warga: *Bond Returns, Liquidity, and Missing Data*. "Journal of Financial and Quantitative Analysis" 1992, Vol. 27, pp. 605-617; A. Kamara: *Liquidity, Taxes, and Short-Term Treasury Yields*. "Journal of Financial and Quantitative Analysis" 1994, Vol. 29, pp. 403-416; L.E. Crabble, C.M. Turner: *Does the Liquidity of a Debt Issue Increase with Its Size? Evidence from the Corporate Bond and Medium-Term Note Markets.* "Journal of Finance" 1995, Vol. 50, pp. 1719-1734; E.J. Elton, C. Green: *Tax and Liquidity Effects in Pricing Government Bonds.* "Journal of Finance" 1998, Vol. 53, pp. 1533-1562; E.J. Elton et al.: *Explaining the Rate Spread on Corporate Bonds.* "Journal of Finance" 2001, Vol. 56, pp. 247-277; M.J. Fleming: *Are Larger Treasury Issues More Liquid? Evidence from Bill Reopenings*. "Journal of Money, Credit and Banking" 2002, Vol. 3, pp. 707-735; F. Longstaff: *The Flight-To-Liquidity Premium in U.S. Treasury Bond Prices.* "Journal of Business" 2004, Vol. 77, pp. 511-526; J. Driessen: *Is Default Event Risk Priced in Corporate Bonds?* "Review of Financial Studies" 2005, Vol. 18, pp. 165-195.

[3] M. Boss, M. Scheicher: *The Determinants of Credit Spread Changes in the Euro Area.* "BIS Papers" 2002, No. 12, pp. 181-199.

[4] P. Houweling et al.: *Comparing Possible Proxies of Corporate Bond Liquidity.* "Journal of Banking & Finance" 2005, Vol. 29, pp. 1331-1358.

Jankowitsch et al. measure the impact of liquidity on European Monetary Union (EMU) government bond prices and find significant results for two liquidity proxies[5].

The objective of this study is to extend the current literature in a number of ways. First of all, the effect of taxes on prices of German bonds after the introduction of the Euro in 1999 is estimated.

A comprehensive sample of German government bonds, ranging from January 1999 to October 2006, allows for an extensive inspection of this effect and its variation over time. Furthermore, the applied method allows analyzing how the effect depends on bond maturity. Subsequently, a sample of German covered bonds ranging again from January 1999 to October 2006 is used to estimate liquidity effects in the German bond market. Unlike many other studies before that examined ordinary corporate bonds, this study uses covered bonds because of their unique safety. Contrary to ordinary corporate bonds that are affected by default risk and recovery risk, most German covered bonds and all bonds in this study are AAA-rated by the main rating agencies and therefore have credit standings comparable to government bonds. These special qualities facilitate the estimation of liquidity risk premia and allow for an accurate identification of the term structure of liquidity spreads. Of course, this procedure also enables us to analyze the variation of liquidity spreads over time.

1. Research methodology

German government bonds are bonds issued by the German Finance Agency. At the end of 2006, the volume of German government bonds outstanding added up to EUR 892 billion (Bundesanleihen EUR 560 billion, Bundesobligationen EUR 186 billion and Bundesschatzanweisungen EUR 146 billion). A high level of liquidity of these bonds is guaranteed through large issue volumes, listing bonds in Germany's exchanges and engaging the Bundesbank to undertake price management operations at the exchanges. This gives investors the possibility to buy and sell large amounts of listed securities at any time and at market-related prices.

Although all German coupon bonds are taxed equally, there might be a tax effect because of different coupon levels. A higher coupon means a higher taxable income for investors and it can be assumed that buyers of high-coupon bonds demand compensation in terms of a higher pre-tax yield. Therefore my first research hypothesis is stated in the null form as follows:

H_1: Bonds with high coupons show higher pre-tax yields than otherwise equivalent low-coupon bonds.

[5] R. Jankowitsch et al.: *Measuring the Liquidity Impact on EMU Government Bond Prices*. "The European Journal of Finance" 2006, Vol. 12, pp. 153-169.

In order to test this hypothesis the German government bonds are examined. For every Wednesday during the sample period from January 6, 1999 until October 11, 2006, the government bonds in the sample are divided into three groups of approximate equal size. The first group contains the bonds with lowest coupons the third group the bonds with highest coupons. Then the Nelson-Siegel procedure is employed to estimate two spot curves for every observation date: one curve based on high-coupon government bonds and another curve based on low-coupon government bonds[6]. Because the classification was done within a homogeneous, default-risk free market segment with constant liquidity, the impact of other determinants can be precluded. Differences in yields can therefore only be due to tax effects.

The method introduced by Nelson and Siegel pursues a parsimonious modeling of the term structure of interest rates. It avoids over-parameterization, but allows for monotonically increasing or decreasing spot curves and hump-shaped spot curves. Because it is a parametrically parsimonious model, it can be applied when the number of available bonds is low. This feature is particularly needed when estimating tax effects because of the low number of bonds in the underlying groups. Nelson and Siegel propose that the spot rate curve at time t can be modeled by the function:

$$\mathbf{R_t(T)} = \beta_0 + (\beta 1 + \beta_2)\frac{1 - exp\left(-\frac{\mathbf{T-t}}{\mathbf{v}}\right)}{\frac{\mathbf{T-t}}{\mathbf{v}}} - \beta_2\, exp\left(-\frac{\mathbf{T-t}}{\mathbf{v}}\right)$$

where $\beta_0 > 0$, β_1, β_2 and $\nu > 0$ are the parameters to be estimated, and $T - t$ is the time to maturity.

The spot curve estimates are guaranteed to be smooth by the parsimonious nature of the functional form. The parameters are related to the long-run level of interest--rates, the short rate, the slope of the spot curve and humps in the curve. The Nelson-Siegel method allows us to use coupon, principal payments and prices of all bonds in our sample to estimate two zero-coupon yield curves for every Wednesday over the time period January 6, 1999 through October 11, 2006: one curve based on high--coupon government bonds and another curve based on low-coupon government bonds. The resulting differences between both curves can then be used to test hypotheses 1.

The second aim of this paper is to estimate the effect of liquidity on prices of German bonds. Amihud and Mendelson argue that liquidity affects asset prices because investors require a compensation for bearing transaction costs. Furthermore, illiquid bonds should exhibit excess returns for the risks of holding them. These risks include the risk of running out of cash because it might be impossible to sell the bonds quickly.

[6] C.R. Nelson, A.F. Siegel: *Parsimonious Modeling of Yield Curves*. "Journal of Business" 1987, Vol. 60, pp. 473-489.

Moreover, selling illiquid bonds might cause their transaction price to drop[7]. The second research hypothesis is therefore stated in the null form as follows:

H_2: In the German market, bonds with lower liquidity exhibit higher yields.

When analyzing corporate bonds, it is difficult to isolate the effect of liquidity risk because corporate bond spreads are affected by a number of additional factors like default risk, recovery risk, and jumps. In order to avoid these factors, this thesis uses data on German covered bonds to derive an accurate estimate of liquidity spreads. Covered bonds are securities backed by high-quality mortgage loans or public sector loans. The volume of German covered bonds (Pfandbriefe) outstanding reached its maximum in August 2000 at approximately EUR 1125 billion. In 2006, the German covered bond still had a top position on the European bond market. Outstanding amounts in German covered bonds summed up to approximately EUR 975 billion. So this market is one of the largest bond markets worldwide and it is experiencing considerable developments in terms of its volume, products, and issuers. Still there are only few studies which examine this market segment. Because of their unique safety, which can be explained by the legal framework, covered bonds are popular in Germany where they are called "Pfandbriefe". One important aspect of this market is its outstanding homogeneity, which is also reflected in the ratings awarded to Pfandbriefe. In 1995, an inter-bank agreement in Germany established the market for Jumbo Pfandbriefe. These are covered bonds with issue volumes totaling EUR 1 billion or more that meet certain structural requirements. At the beginning of 2006, German Jumbo Pfandbriefe accounted for 38% of the German covered bond market as a whole. On the one hand, there is no default-risk in the Pfandbrief market. Since the introduction of the German Mortgage Bank Act in 1900, no German mortgage bank has defaulted and there has never been a case of principal default over the entire 225 years of history of Pfandbriefe. On the other hand, investors query liquidity in the German Pfandbrief market. It is a well-known fact that traditional Pfandbriefe exhibit a low liquidity and since the interruption of market making in AHBR (Allgemeine HypothekenBank Rheinboden AG) Jumbo Pfandbriefe in October 2005 liquidity is also in doubt in the Jumbo market. Furthermore, some Jumbos tend to get locked in buy-and-hold portfolios. For these bonds the tradable amount and thus liquidity reduces. Under the assumption that Jumbo Pfandbriefe and German government bonds are homogenous in all respects, but liquidity, the differences in the rates offered on Jumbos and those offered on government bonds can only be due to liquidity differences. A possibility to test the second hypothesis in then to estimate

[7] Y. Amihud, H. Mendelson: Op. cit.

the spread between Jumbo Pfandbrief rates and government bond rates. Therefore, the Nelson-Siegel methodology is again employed to estimate zero-coupon yield curves for both German government bonds and German Jumbo Pfandbriefe for every Wednesday over the time period January 6, 1999 through October 11, 2006[8].

2. Data description

Altogether the sample used in this study comprises 387 Jumbo Pfandbriefe and 125 German government bonds (54 Bundesanleihen, 36 Bundesobligationen, and 35 Bundesschatz-anweisungen) denominated in EUR. The data set is restricted to fixed-rate, AAA-rated straight bonds with annual coupon payments. Bonds with a remaining time to maturity of less than 1 year are excluded. All bonds were included in Merrill Lynch's Pan-Europe Broad Market Index. This index tracks the performance of the major investment grade bond markets in the Pan-Europe region. The bond data used in this study are obtained from Bloomberg. Weekly closing bid prices of Jumbo Pfandbriefe and government bonds are collected at every Wednesday from January 6, 1999 until October 11, 2006. Thus, this study includes price data on Jumbos and Bunds for 406 days during the sample period. For the most part the collected prices are transaction prices, but even if there are no transaction prices an actual bid quote for Bunds and Jumbos can almost always be obtained. In addition, descriptive data on the selected bonds including issuer, coupons, maturity dates, issued amount, and ratings are downloaded. Currently Jumbos are required to have a minimum issue volume of EUR 1 billion, but Pfandbriefe which have been issued before April 28, 2004 can keep the status of a Jumbo even if they have an issue volume of less than EUR 1 billion. The average size of Jumbos included in our data set is approximately EUR 1.4 billion. Some Jumbos have a volume of up to EUR 5 billion. Coupon rates on Jumbos in the sample range between 2.5% and 6.75% and average out at 4.42%. The government bonds included in the sample have average and maximum sizes of EUR 12 and 27 billion, respectively. Their coupon rates are 4.76% on average and range between 2% and 9%.

3. Research results and discussion

3.1. Tax effects

[8] C.R. Nelson, A.F. Siegel: Op. cit.

The average differences of spot rates in group 1 (low coupon bonds) and group 2 (high coupon bonds) are displayed in Table 1 and Figure 1 for maturities of 2, 3, and 4 years. They are calculated on the basis of absolute differences in the periods from January to June and from July to December respectively. Only in the second half of the year 2006 the period ranges from July to October.

Table 1

Average tax effects in the German bond market

Average Differences of Spot Rates in Basis Points							
Year (Months)/Time to maturity	2		3		4		CDiff
1999 (Jan-Jun)	4.82	(1.05)	4.44	(0.82)	4.65	(1.21)	3.35
1999 (Jul-Dec)	9.75	(1.36)	5.89	(1.38)	4.88	(1.79)	3.41
2000 (Jan-Jun)	12.57	(2.25)	8.85	(1.60)	6.60	(1.47)	2.96
2000 (Jul-Dec)	6.73	(1.89)	5.01	(1.37)	3.91	(1.32)	2.70
2001 (Jan-Jun)	6.03	(0.48)	4.65	(1.48)	–		2.63
2001 (Jul-Dec)	5.74	(1.05)	7.69	(1.95)	–		2.48
2002 (Jan-Jun)	6.74	(1.36)	8.96	(1.25)	–		2.70
2002 (Jul-Dec)	6.07	(0.76)	–		6.96	(0.51)	2.48
2003 (Jan-Jun)	2.94	(0.80)	4.06	(1.24)	3.98	(1.05)	2.48
2003 (Jul-Dec)	3.63	(0.72)	2.67	(0.47)	2.27	(0.83)	2.32
2004 (Jan-Jun)	2.08	(0.70)	2.03	(0.55)	–		2.26
2004 (Jul-Dec)	3.03	(0.33)	2.82	(0.79)	–		2.33
2005 (Jan-Jun)	0.36	(0.72)	2.52	(0.76)	3.41	(1.45)	2.32
2005 (Jul-Dec)	3.39	(0.38)	2.29	(0.40)	1.61	(0.45)	2.39
2006 (Jan-Jun)	2.62	(0.43)	1.13	(0.48)	0.50	(0.59)	2.45
2006 (Jul-Oct)	4.15	(1.15)	2.49	(0.99)	1.69	(1.01)	2.23

Source: Own calculations.

The first numbers in columns 2, 3, and 4 correspond to the average differences of spot rates. The numbers given in parenthesis represent the standard deviations of absolute differences. In some cases – particularly with regard to the four year spot rate – there are not enough bonds available in the corresponding maturity segment. In these cases, the absolute differences of spot rates could not be calculated and the average differences are not shown in Table 1. Nevertheless, clear results are obtained in most instances. The spot rates calculated on the basis of bonds in group 3 (high coupon bonds) are on average 5.04 basis points (maturity 2 years), 4.37 basis points (maturity 3 years), and 3.68 basis points (maturity 4 years) higher than the correspond-

ing spot rates based on bonds in group 1 (low coupon bonds). This clearly confirms Hypothesis 1. Obviously, there is a tax-effect in the German bond market. Average differences of spot rates are always positive and range between 0.36 basis points (2005 Jan-Jun), maturity 2 years) and 12.57 basis points (2000 Jan-Jun), maturity 2 years). For a maturity of 3 years, average differences of spot rates range between 1.13 basis points (2006 Jan-Jun) and 8.96 basis points (2002 Jan-Jun). In the case of 4 year spot rates one can observe average differences between 0.5 basis points (2006 Jan-Jun) and 6.96 basis points (2002 Jul-Dec). So the effect seems to be stronger for low-maturity bonds. A possible explanation for this observation could be that investors who invest their money in short-term bonds are more sensitive to tax effects.

Over the sample period, the differences tend to decline. During the time period January 2003 – October 2006 they are substantially lower than 5 basis points whereas they are higher than 5 basis points in the majority of cases during the time period January 1999 – December 2002. In order to explain this reduction of spot rate differences, column 5 of Table 1 shows the differences of average coupons in group 1 and group 3. It can be seen that these differences also tend to decline over the sample period, which might explain the decline in spot rate differences.

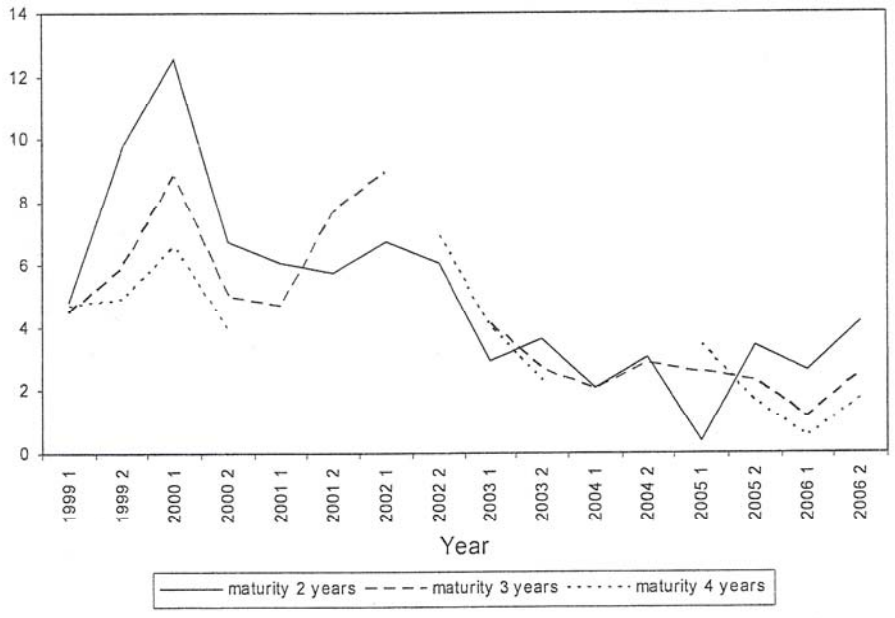

Figure 1. Average tax effects (average differences of spot rates in basis points)

Source: Own calculations.

The figure above displays the time series of average differences of spot rates in group 1 (low coupon German government bonds) and group 2 (high coupon German government bonds) for maturities of 2, 3, and 4 years over the period from January 1999 to October 2006. The average differences of spot rates are calculated on the basis of absolute differences in the periods from January to June and from July to December, respectively. Only in the second half of the year 2006 the period ranges from July to October.

Although a tax-effect is found, it seems to be rather small. In order to assess whether the detected differences are in accordance with theoretical predictions we consider the following situation: In a market we have two risk-free coupon bonds each with a remaining time to maturity of 2 years, a nominal value of EUR 100 and annual coupon payments. The first bond pays a coupon of 6% and the second bond pays a coupon of 3%. Investors are obliged to pay a tax of 30% on coupons received and the term structure of interest rates based on after-tax payments is flat at 5%. Investors who have a long position in bond 1 consequently receive an after-tax cash flow of EUR 4.20 after one year and EUR 104.20 after two years. Investors who are long in bond 2 receive EUR 2.10 after one year and EUR 102.10 after two years. The prices of these bonds are obtained by discounting the cash flows. For bond 1 and 2 we get EUR 98.51 and EUR 94.61, respectively. Therefore a pre-tax yield of 6.82% and 5.94% is found for bond 1 and bond 2, respectively. Of course, this is only a simple example which does not take into consideration all the circumstances influencing the real situation. Nevertheless, the resulting yield-difference between bond 1 and bond 2 of 88 basis points gives an indication of the tax-effect which can be expected on a theoretical basis. Compared to this theoretical effect, the empirical effect is obviously too small. Therefore, it can be concluded that many investors in the German bond market have not yet fully recognized the influence of taxes on their private investment decisions.

3.2. Liquidity effects

Table 2 contains the average annualized spot rates on German government bonds and Jumbo Pfandbriefe and their differences (spreads). On each observation date, the number of bonds in the sample is sufficient to ensure an accurate estimate of spot rates for both market segments and for all maturities between 2 and 10 years. Panel A contains the average spot rates and spreads over the almost eight year period from January 6, 1999 to October 11, 2006. Because spot rates and differences are much higher in the first four years of the sample period, average spot rates, and differences are calculated over two subsamples. Panel B of Table 2 contains the averages for the first four years and panel C contains the averages for the final years.

Table 2

Average spot rates and liquidity-spreads in the German bond market

Maturity	Government Bonds (%)	Jumbo Pfandbriefe (%)	Liquidity-Spread (%)
Panel A: 01/06/1999-10/11/2006			
2Y	3.308	3.435	0.127
3Y	3.509	3.662	0.153
4Y	3.688	3.864	0.176
5Y	3.847	4.044	0.197
6Y	3.987	4.201	0.214
7Y	4.109	4.339	0.230
8Y	4.216	4.459	0.243
9Y	4.310	4.565	0.255
10Y	4.392	4.657	0.265
Panel B: 01/06/1999-12/26/2002			
2Y	3.943	4.091	0.148
3Y	4.117	4.310	0.193
4Y	4.273	4.507	0.234
5Y	4.412	4.681	0.269
6Y	4.534	4.833	0.299
7Y	4.641	4.964	0.323
8Y	4.734	5.078	0.344
9Y	4.816	5.176	0.360
10Y	4.888	5.261	0.373
Panel C: 01/02/2003-10/11/2006			
2Y	2.641	2.746	0.105
3Y	2.869	2.980	0.111
4Y	3.074	3.189	0.115
5Y	3.254	3.374	0.120
6Y	3.412	3.538	0.126
7Y	3.551	3.682	0.131
8Y	3.672	3.810	0.138
9Y	3.778	3.923	0.145
10Y	3.871	4.023	0.152

Source: Own calculations.

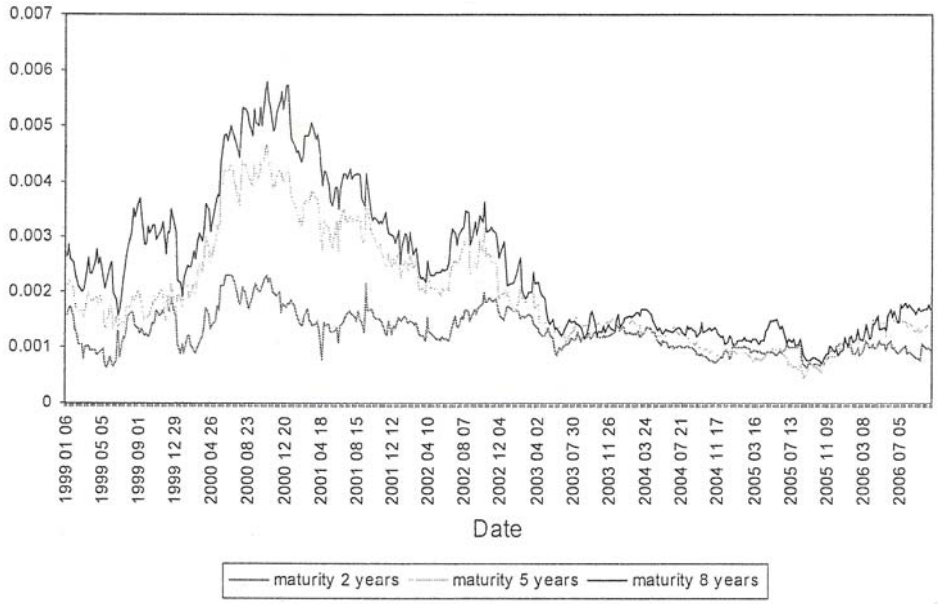

Figure 2. Liquidity effects (liquidity spreads in the German bond market)

Source: Own calculations.

Figure 2 shows the time series of Jumbo Pfandbrief spreads over governments on 2-, 5-, and 8-year spot payments over the period from January 6, 1999 to October 11, 2006. Obviously, bonds with lower liquidity exhibit higher yields. Therefore, Hypotheses 2 is confirmed.

Because average coupon rates of German government bonds and Jumbo Pfandbriefe in the underlying sample are approximately equal, taxes will have a negligible effect on the spread between rates on Jumbos and government bonds. Moreover, it was already stated in Section 2 that there is no default-risk in the German Pfandbrief market. The yield differences in Table 2 and Figure 2 give, therefore, exact estimates of the liquidity premium. On average, normal term structures of spot rates and liquidity spreads are found over the almost eight year period and over the two subsamples. Therefore, long maturity bonds exhibit a higher liquidity premium than short maturity bonds which can be explained by the underlying risk. In the case of illiquid bonds with short time to maturity, the nominal value will be paid back within a short period of time. So even if it is not possible to sell this bond, the liquidity risk is rather small in comparison with bonds that exhibit a considerable remaining time to maturity. If a bond is hard to sell and does not mature in the near future, liquidity risk is high and therefore investors will demand a higher yield. The logical consequence is an upward sloping spread curve.

Figure 2 gives further information about the time series behavior of liquidity spreads: Starting in January 1999 at an average level of approximately 21 basis points and maximum and minimum spread levels of 15 and 28 basis points, respectively, the average level raises to approximately 40 basis points in the second half of the year 2000. In the years 1999 and 2000 as well as in the following years 2001 and 2002 the term structure remains mostly normal. The maximum spread level increases to a global maximum of 58 basis points for a maturity of eight years in October 2000. From January 1999 to October 2000, spreads on 2-year spot payments increase only marginally to approximately 20 basis points. Thus, the slope of the spread curve steepens. However, in the years 2001 and 2002 a reverse movement is found: the spread curve flattens and the average level falls from 35 to 20 basis points. In the year 2003 the spread curve continues to fall to less than 15 basis points. In the years 2004 and 2005 a decreasing average spread-level, which reaches its all-time low of 6 basis points on August 31, 2005, can be observed again. A few days before, on August 24, 2005 the global minimum of 5 basis points is found in the 5-year category. In the following months till the end of the sample period, liquidity spreads widen to an average level of approximately 14 basis points and the term structure again develops the well-known normal form. However, over the entire sample period, liquidity spreads tend to decline. This can be due to the increasing use of electronic trading platforms and competition among market makers. Furthermore, market participants prefer to hold highly liquid securities such as German government bonds rather than less liquid securities, during times of crisis. In the years 2000-2002 German investors were exposed to a bundle of adverse conditions, including a stock market crash, economic downturn, and terrorist acts in the USA. Due to increased uncertainty, a growing demand for highly liquid securities and a weakening demand for less liquid securities resulted in widening liquidity spreads.

Conclusions

The study confirms that tax effects exist in the German bond market during the period January 1999 to October 2006. A higher coupon means a higher taxable income for investors. Therefore, bonds with high coupons show higher pre-tax yields than otherwise equivalent low-coupon bonds, but compared to theoretical predictions the empirical tax effect is too small. It ranges between 0.36 and 12.57 basis points and tends to decline over the sample period. Tax effects are stronger for low-maturity bonds.

Furthermore, this article examines whether there is a liquidity effect in the German bond market. This is done by comparing spot rates on covered and government bonds. Because the selected bonds are homogeneous in all respects, but liquidity, the differences in rates can be attributed entirely to liquidity. Over the period

from January 1999 to October 2006, the spread between German covered bonds and government bonds is always positive and averages 21 basis points. Therefore, this study provides evidence supportive of the existence of a liquidity effect in the German bond market. In the majority of cases long maturity bonds exhibit a higher liquidity premium than short maturity bonds and increasing uncertainty among investors is assumed to cause higher liquidity spreads.

References

Amihud Y., Mendelson H.: *Liquidity Maturity, and the Yields on U.S. Treasury Securities*. "Journal of Finance" 1991, Vol. 46, pp. 1411-1425.

Boss M., Scheicher M.: *The Determinants of Credit Spread Changes in the Euro Area*. "BIS Papers" 2002, 12, pp. 181-199.

Cox J.C., Ingersoll J.E., Ross S.A.: *A Theory of the Term Structure of Interest Rates*. "Econometrica" 1985, Vol. 53, pp. 385-407.

Crabble L.E., Turner C.M.: *Does the Liquidity of a Debt Issue Increase with Its Size? Evidence from the Corporate Bond and Medium-Term Note Markets*. "Journal of Finance" 1995, Vol. 50, pp. 1719-1734.

Driessen J.: *Is Default Event Risk Priced in Corporate Bonds?* "Review of Financial Studies" 2005, Vol. 18, pp. 165-195.

Elton E.J., Green C.: *Tax and Liquidity Effects in Pricing Government Bonds*. "Journal of Finance" 1998, Vol. 53, pp. 1533-1562.

Elton E.J., Gruber M.J., Agrawal D., Mann C.: *Explaining the Rate Spread on Corporate Bonds*. "Journal of Finance" 2001, Vol. 56, pp. 247-277.

"Euro Area Issues Statistics", EBC, July 2007 and December 1998 to July 1999.

Fisher L.: *Determinants of Risk Premiums on Corporate Bonds*. "Journal of Political Economy" 1959, Vol. 67, pp. 217-237.

Fleming M.J.: *Are Larger Treasury Issues More Liquid? Evidence from Bill Reopenings*. "Journal of Money, Credit and Banking" 2002, Vol. 3, pp. 707-735.

Houweling P., Mentink A., Vorst T.: *Comparing Possible Proxies of Corporate Bond Liquidity*. "Journal of Banking & Finance" 2005, Vol. 29, pp. 1331-1358.

Jankowitsch R., Mösenbacher H., Pichler S.: *Measuring the Liquidity Impact on EMU Government Bond Prices*. "The European Journal of Finance" 2006, Vol. 12, pp. 153-169.

Kamara A.: *Liquidity, Taxes, and Short-Term Treasury Yields*. "Journal of Financial and Quantitative Analysis" 1994, Vol. 29, pp. 403-416.

Longstaff F.: *The Flight-To-Liquidity Premium in U.S. Treasury Bond Prices*. "Journal of Business" 2004, Vol. 77, pp. 511-526.

Nelson C.R., Siegel A.F.: *Parsimonious Modeling of Yield Curves*. "Journal of Business" 1987, Vol. 60, pp. 473-489.

Sarig O., Warga A.: *Some Empirical Estimates of the Risk Structure of Interest Rates*. "Journal of Finance" 1989, Vol. 44, pp. 1351-1360.

Warga A.: *Bond Returns, Liquidity, and Missing Data*. "Journal of Financial and Quantitative Analysis" 1992, Vol. 27, pp. 605-617.