

The German sub-national government bond market: evolution, yields and liquidity

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Abstract:

The paper presents a comprehensive data set of all bonds issued by the sixteen German states (Länder) since 1992. It thus provides a complete picture of a capital market comparable in size to funds raised in the German fixed income market for corporations. The quantitative analysis reveals that Länder follow different issuing strategies: while some concentrate to a greater extent on large issues or issue joint bonds with other Länder (Jumbos), others rely more on comparatively small but frequent issues. Moreover, some Länder issue a significant volume-share of their bonds in foreign currencies. Suitable bonds are used to compute yields for the respective Länder at a daily frequency. In addition, we construct a measure of liquidity based on the standard deviation of yields of those bonds that are used to compute the average yield.

Keywords: sovereign bond market, yields, liquidity, fiscal federalism, Germany

JEL-Classification: E43, E44, G10, G12, G18, H63, H74

Non-technical summary

Imposing fiscal discipline on governments, on the local, as well as the regional and the federal level, is in the focus of international policy makers and academics (Ter-Minasian 1997). A frequently discussed reform option consists of increasing fiscal discipline through capital markets, also for German states (Länder). While the question of capital market discipline is a hotly discussed topic in Germany, the German sub-national government bond market has received virtually no attention so far from empirical researchers. A potential reason for this paucity of studies of the German sub-national government bond market is the lack of data.

The present paper presents the most comprehensive data set on the German Länder bond market. We compile the full recorded issuance activity of all sixteen Länder on a single bonds basis. We document substantial heterogeneity in issuing strategies of the Länder: while some concentrate on large issues or issue joint bonds with other Länder (Jumbos), others rely more on comparatively small but frequent issues. Moreover, some Länder issue a significant volume-share of their bonds in foreign currencies. Based on the panel of bonds issued by the Länder, we compute time series of yields at a daily frequency measured as a weighted average of all traded bond yields for several maturity classes for each Land. Moreover, we compute a measure of bond liquidity based on the standard deviation of yields of those bonds entering the respective average yield. This measure shows a joint liquidity event in the summer of 2007.

From 2001 until early 2005 Länder spreads to the Bund were falling, matching the decline in other bond markets' spreads, like corporate bond spreads or emerging market spreads and were accompanied by strong issuance activity. Spreads picked up in 2005 and the rise since summer of 2007 is particularly steep. The average spread of Länder bonds to the Bund over the whole sample is between 8 and 28 basis points, with substantial variations. Jumbo bonds exhibit an average spread of 15 basis points, which is less than those of the individual bonds of the participating Länder, demonstrating the beneficial effect of enhanced liquidity and joint liability to the cost of borrowing.

Nicht-technische Zusammenfassung

Staatlichen Stellen auf kommunaler, regionaler und Bundesebene Finanzdisziplin aufzuerlegen, ist weltweit ein Anliegen (Ter-Minasian, 1997). Eine in diesem Zusammenhang häufig erörterte Reformoption besteht in einer Verschärfung der Haushaltsdisziplin über die Kapitalmärkte, und zwar in Deutschland auch auf Ebene der Bundesländer. Der Aspekt der Marktdisziplin wird zwar in Deutschland eingehend diskutiert, der Markt für Anleihen staatlicher Stellen unterhalb der Ebene der Zentralregierung wurde aber bisher empirisch praktisch nicht untersucht. Möglicherweise gibt es deshalb so wenige Studien in diesem Bereich, weil keine Daten vorhanden sind.

In diesem Diskussionspapier wird der bislang umfassendste Datensatz über den Markt für Anleihen der Bundesländer vorgelegt. Wir haben die gesamte erfasste Emissionstätigkeit aller sechzehn Länder auf der Ebene einzelner Anleihen zusammengestellt. Dabei stellte sich heraus, dass die Emissionsstrategien der einzelnen Länder sehr unterschiedlich sind: Während die einen sich auf großvolumige Emissionen konzentrieren oder Anleihen gemeinsam mit anderen Bundesländern begeben (Jumbos), greifen andere stärker auf vergleichsweise kleine, aber häufige Emissionen zurück. Darüber hinaus begeben manche Länder volumenmäßig einen beträchtlichen Anteil ihrer Anleihen in Fremdwährung. Ausgehend vom Spektrum der von den Bundesländern emittierten Anleihen berechnen wir für mehrere Laufzeitklassen und für jedes Land Renditezeitreihen auf täglicher Basis, ausgedrückt als gewichteter Durchschnitt der Renditen aller am Markt gehandelten Anleihen. Des Weiteren berechnen wir einen Messwert für die Liquidität von Anleihen, der auf der Standardabweichung der Renditen jener Anleihen beruht, die der jeweiligen Durchschnittsrendite zu Grunde liegen. Dieses Maß zeigt im Sommer 2007 ein gemeinsames liquiditätsrelevantes Ereignis an.

Von 2001 bis Anfang 2005 verengten sich die Spreads der Länder gegenüber Bundesanleihen. Dies entsprach dem Rückgang der Zinsabstände in anderen Segmenten des Rentenmarktes, zum Beispiel der Spreads von Unternehmens- oder Emerging-Markets-Anleihen, und ging mit einer kräftigen Emissionstätigkeit einher. Die Spreads stiegen im Jahr 2005, und seit dem Sommer 2007 wird ein besonders steiler Anstieg verzeichnet. Über die gesamte Stichprobe betrachtet liegt die durchschnittliche Zinsdifferenz zwischen Länder- und Bundesanleihen bei 8 bis 28 Basispunkten, wobei erhebliche

Schwankungen beobachtet werden. Die Jumbo-Anleihen weisen im Durchschnitt einen Spread von 15 Basispunkten auf. Dieser Wert liegt unter den Spreads der von den beteiligten Ländern einzeln emittierten Bonds, was darauf hindeutet, dass sich erhöhte Liquidität und Gesamthaftung positiv auf die Kreditkosten auswirken.

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The German sub-national government bond market: evolution, yields and liquidity¹

1 Introduction

Imposing fiscal discipline on governments, on the local, as well as the regional and the federal level, is in the focus of international policy makers and academics (Ter-Minasian 1997). A frequently discussed reform option consists of increasing fiscal discipline through capital markets. Several studies support the notion that US states' and cities' capital markets increase risk premia in response to deterioration of fiscal fundamentals (Capeci (1991, 1994), Alesina, De Broeck, Prati, and Tabellini (1992), Bayoumi, Goldstein, and Woglom (1995)). Similarly, studies show the existence of risk premia reactions to fiscal policy in Europe (Copeland and Jones (2001), Codogno, Favero, and Missale (2003), Bernoth, von Hagen, and Schuknecht (2004), Hallerberg and Wolff (forthcoming), Bernoth and Wolff (forthcoming)). While the question of capital market discipline is thus a hotly discussed topic, the German sub-national government bond market has received virtually no attention so far from empirical researchers. To our knowledge, only two studies investigate the German sub-national bond market, both from a public finance angle. They rely on single bond issues respectively on on-the-run bonds (Heppke-Falk and Wolff (2008) and Lemmen (1999)). A potential reason for this paucity of studies of the German sub-national government bond market is the lack of data. Thus we provide a comprehensive data set of both, bond volume issued and yields for each state (Land).

Traditionally, German states (Länder) borrow mainly from banks. These in turn refinance the granted loans by issuing Pfandbriefe (covered bonds). The German Pfandbrief market has a special segment for Public Pfandbriefe (Öffentliche Pfandbriefe), i.e., bonds covered by a collateral pool consisting of loans to the country's different regional authorities. Seeking finance for the German unification, Länder also turned to the capital market in the early

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1990s. While total net debt growth remained broadly stable until 2003, the means of financing changed.² Noticeably from the late 1990s on, Länder have substituted bank debt with bonds. Direct bond issues turned more attractive for Länder as capital markets deepened. Figure A-1 in the appendix indicates the gain of directly approaching capital markets. The yield spread of Öffentliche Pfandbriefe to Länder bonds is regularly positive.³



Figure 1: Quantitative evolution of the German Länder bond-market, Bund issues, corporate bonds and Länder debt with banks. "Corporate bonds" refer to the combined German commercial and corporate bond market. Figures show quarterly net increase/ decrease. 1992Q1-2007Q3. Source: Deutsche Bundesbank, authors' calculations.

Issuance activity by the Länder since 1992 has been slightly higher than in the combined German commercial paper and corporate bond market (Figure 1). In the first three quarters of 2007 Länder net volumes of issues even exceeded bond sales on the federal level, due to weak gross issuance of bonds by the Bund in the wake of ample tax revenues. The German sub-national bond market thus constitutes in terms of net issuance a quantitatively important segment of the German bond market, which has received very little coverage

²Figure A-3 shows that the net issuance of bonds derived from capital market data closely match debt statistics.

³No direct interest rate statistic for Länder loans is available. But yields of Öffentliche Pfandbriefe are a lower bound for the interest rate for loans granted to Länder, as they determine the refinancing cost of the involved banks.

so far.

The present paper presents the most comprehensive data set on the German Länder bond market. We compile the full recorded issuance activity of all sixteen Länder on a single bond basis. We document substantial heterogeneity in issuing strategies of the Länder: while some concentrate on large issues or issue joint bonds with other Länder (Jumbos), others rely to a greater extent on comparatively small but frequent issues. Moreover, some Länder issue a significant volume-share of their bonds in foreign currencies. Based on the panel of bonds issued by the Länder, we compute time series of yields at a daily frequency measured as a weighted average of all traded bond yields with similar maturity on a given day for each Land. Moreover, we compute a measure of liquidity based on the standard deviation of yields of those bonds used to compute the respective average yield.

The remainder of the paper is structured as follows. The next section provides a detailed discussion of the data set and the evolution of the German sub-national bond market. The last section concludes and gives an outlook of how this new and rich data set can be used for future research.

2 Data

2.1 Quantitative Evolution

Our data set covers the period from 1992 to the third quarter 2007. We evaluate the Bundesbank issuance statistic, which records the German primary bond market. All in all, German Länder issued 3099 bonds since 1992. The number of issues was particularly high in the early 1990s, when Länder increasingly employed the capital market to finance costs related to German unification (see Figure 2). In the following years issuance activity was moderate, both in numbers of transactions and volume. Bond sales picked up in 2000 and were high during the recession of 2002-2004, ebbing thereafter. The evolution of the volume of issues is similar to that of the number of issues. Here, we observe a strong increase in volume from a low in 1999 to a peak in 2003-2005 (Figure 3).

Figures 4 and 5 show the distribution of cumulated issues and volume across Länder. Clearly, North Rhine Westphalia as the largest Land is the most active state in the bond market. Saxony-Anhalt has relative to its size a large number of issues. With respect to funds raised, Berlin stands out among

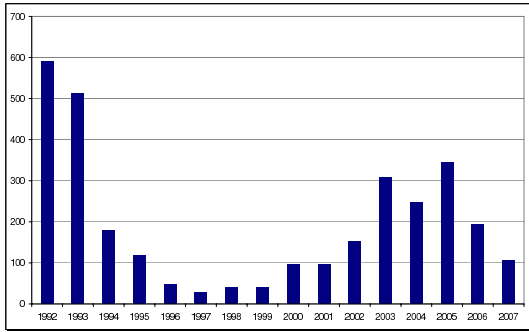


Figure 2: Number of issues of all German Länder per year.

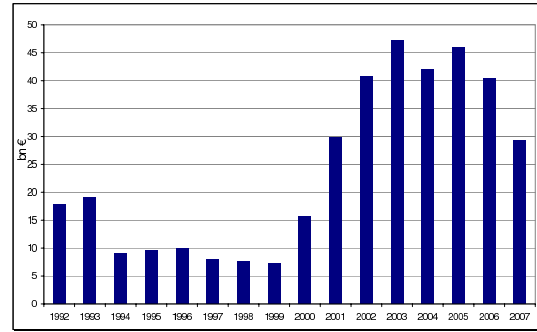


Figure 3: Gross issue-volume per year.

the states, being second only to four times larger North Rhine Westphalia, which reflects the financial difficulties of the capital. Länder use two channels

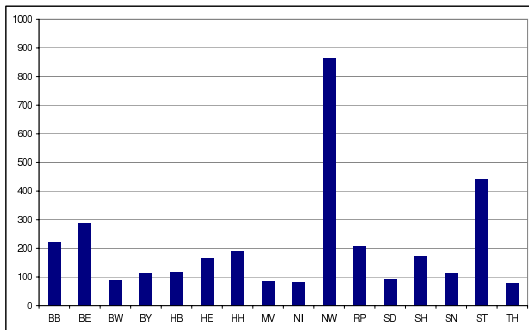


Figure 4: Number of issues per German Land during 1992-2007Q3.

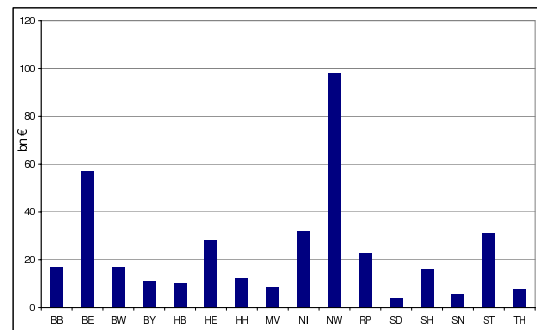


Figure 5: Issue-volume per German Land during 1992Q1-2007Q3. Gross sales.

to approach the bond market: private placements and public issues. In general, the latter are of substantially higher volume, thus reducing the liquidity premium demanded by investors.⁴ In contrast, privately placed bonds can be tailored to the needs of Länder treasurers. This dichotomy can also be read off in the distribution of the issue size. Over the full sample, the mean of a Land's bond volume was approximately €120m, while the median was slightly below €30m (Figure A-2 in the appendix). The comparatively wealthy states of Baden-Wuerttemberg, Bavaria and Hesse, tend to issue a higher proportion of traded bonds, resulting in higher average issue volumes. Noteworthy, Lower Saxony has concentrated on a rather small number of transactions, selling on average paper worth €488m per transaction. Recently, Länder generally rely

⁴The liquidity premium compensates for risk, that an investor is not able to buy or sell a desired volume at the present market price.

increasingly on traded debt. Hence, the mean issue size almost doubled from 2004 to 2007.

In our data set, we distinguish straight bonds, paying a fixed coupon and having a fixed maturity, from other bonds, e.g., those having embedded call or put options, or variable or contingent interest payments. By definition, structuring features can both raise or lessen a bond’s yield relative to a straight bond. The scope of features is large. Next to simple termination options for either issuer or investor, different forms of variable interest rates are used. Some Länder have also issued ”exotic” bonds, e.g., paper indexed to commodity prices and an islamic bond. The bond characteristics are taken from the Bundesbank primary issuance statistic and Bloomberg. Länder issue bonds for public trading as well as in private sales. While traded bonds are probably fully covered by the Bloomberg database, for private placements bond characteristics are only partly available. Thus the category ”non available” is a conservative estimate of private placements.

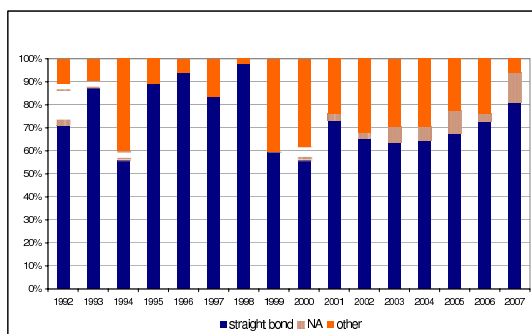


Figure 6: Type per year for all Länder, volume.

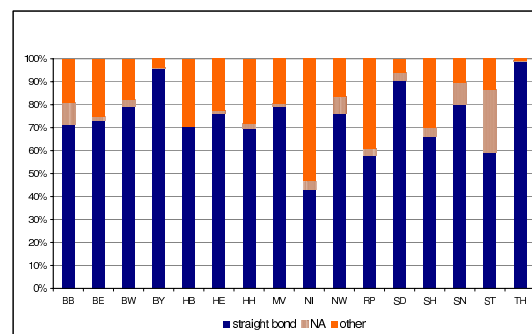


Figure 7: Type per German Land during 1992-2007Q2, volume.

As Figures 6 and 7 show, straight bonds are the dominant source of funds. However, important differences both across states and time can be observed. Lower Saxony has the largest share of bonds with some features, issuing more than half of its volume in that category. All other states use straight bonds for at least half of the capital raised. The share of straight bonds in total volume issued has been increasing since 2003. This is consistent with the increase of the mean issue size, as both hint to a greater use of actually traded bonds.

Bond issuance in foreign currency was not allowed before 1999. Since then, six Länder have employed bond debt denominated in foreign currency with varying intensity (Figure 9). Bond issues in foreign currency are comparatively small; the average domestic currency bond is about three times larger

in volume. During 2003-2005 the share of issues in foreign currency was especially high peaking at almost ten percent in volume (Figure 8).⁵ Outstanding

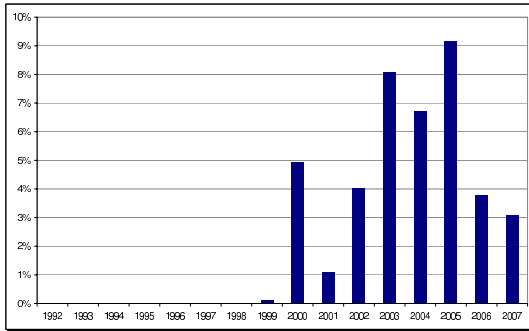


Figure 8: Share of foreign currency issues per year (volume weighted)

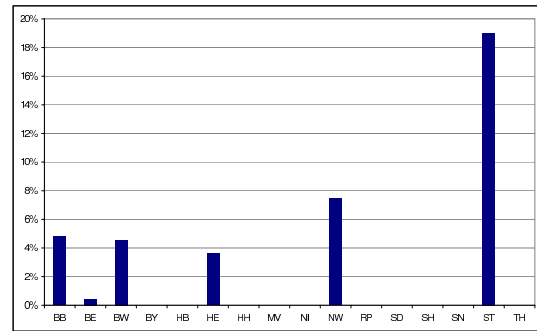


Figure 9: Share of foreign currency issues per Land, volume.

is Saxony-Anhalt, which issued more than 18 percent of total volume during 1992-2007 in foreign currencies. Since until 1999 foreign currency issues were not undertaken, the share subsequently was significantly higher, reaching 51 percent in 2005! North Rhine Westphalia was the second most active Land in terms of foreign currency issuance measured as a share of issued volume and the largest issuer in absolute terms, peaking at 22 percent in 2003. Up to now, Länder issued bonds in 15 foreign currencies, though more than 80 per cent of volume was issued in Yen, Swiss Francs and US-Dollar. Figure A-8 exhibits a breakdown by currency.

A special segment of the Länder bond market are the so called Jumbos. These are bonds issued by a group of Länder. So far, 33 Jumbos have been issued by syndicates of five to seven Länder, with the exception of the particularly large Jumbo of 1997 which was shared by ten Länder. So far, all Jumbos have been arranged as straight bonds and the average issue size is slightly higher than €1bn, more than seven times the size of an average Land issue. Participants of the Jumbos program are mostly countries which are either small by size or population (Figures 10 and 11). Jumbos are more liquid than typical Länder bonds, saving the state treasurers part of the liquidity risk

⁵To the extent of our knowledge, Länder do not take exchange rate risk. The hedging of exchange rate risk is regulated by each Land in the budget laws (Haushaltsgesetz). For example, in the case of Saxony-Anhalt the law of 2005 states that "in principle" (grundsätzlich) the exchange rate risk has to be covered by derivatives (3 (5) Gesetz über die Feststellung des Haushaltsplans für die Haushaltsjahre 2005 und 2006 (Haushaltsgesetz 2005/2006 - HG 2005/2006 -)). However exceptions are allowed and can be regulated by the finance ministry of the Land. According to the ministry, however, no exceptions are granted and the exchange rate risk is fully hedged.

premium compared to a rather small single-issuer bond. From the investors point of view, Jumbos have the advantage of joint liability of the involved Länder.

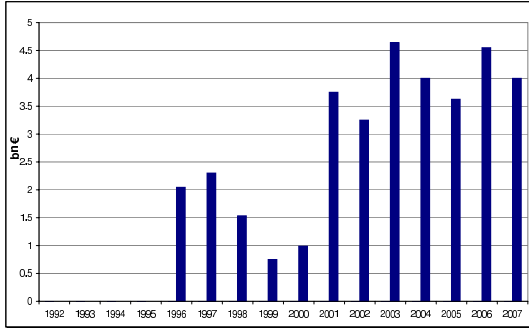


Figure 10: Issues of Länder Jumbos per year, volume.

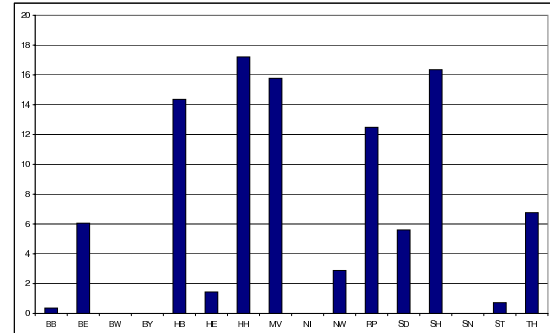


Figure 11: Share of Jumbos in total issues per Land.

2.2 Yields and Liquidity

We group bonds with respect to maturity into four classes (Figure 12). Länder issue predominantly bonds with a maturity of four to eleven years, while long-

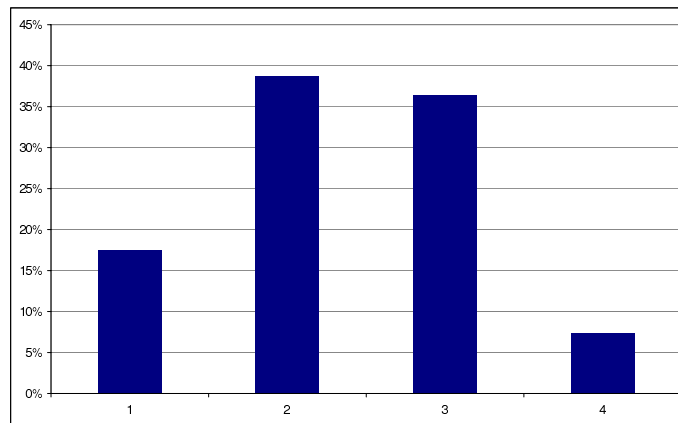


Figure 12: Share of volume-weighted issues at different maturities. Class 1: 0-4 years; class 2: 4-7 years; class 3: 7-11 years; class 4: >11 years

running bonds are rather uncommon for German Länder. We use 11 instead of the typical 10 years as the boundary for class 3 since many bonds are issued with a maturity of slightly above 10 years.

For carrying out price related analysis, we compute time series of bond yields for each Land. For the sake of computational simplicity, we restrict our sample to straight bonds. As more than 1700 bonds remain in our sample, this restriction does not limit the quality of our data. We obtain yield to

maturity for each bond from Datastream. We then calculate the average yield of each Land's bonds in a given maturity class at a daily frequency, weighting observations by outstanding volume. We eliminate non-traded observations from the calculation of the average yield. A bond is deemed non-traded, if its yield does not change for five consecutive days.

Figures A-9 to A-24 in the appendix plot the time series of the average daily yield for each Land. We display results for the maturity class 4-7 years. This turned out to be the most liquid segment of the Länder bond market and we obtain the most continuous time series. For other maturity classes, the time series exhibit several breaks indicating a lack of liquid bonds. Especially low issuance activity in the mid 1990s hampers the computation of uninterrupted time series.

Most noticeable is the general fall in interest rates from the mid-1990s until mid-2005. The fall was interrupted by significant increases in 2000. Moreover, we observe an upward trend since mid-2005 in line with Bund yields. Searching for Länder characteristics, we employ federal bonds (Bunds) as a benchmark. Spreads to Bunds moderated during the mid to late 1990s and rose thereafter in accordance with low issuance activity. From 2001 until early 2005 Länder spreads were falling, matching the decline in other bond markets' spreads, like corporate bond spreads or emerging market spreads and were accompanied by strong issuance activity. Spreads picked up in 2005 and the rise since summer of 2007 is particularly steep. The spreads of selected Länder are depicted in Figures A-25 - A-28 in the appendix. The average spread of Länder bonds to Bunds over the whole sample is between 8 and 28 basis points, with substantial variations (see A-29 in the appendix). Hamburg enjoys the lowest average spread, though dispersion⁶ of Hamburg's spread to the Bund is rather pronounced. Jumbo bonds exhibit an average spread of 15 basis points, which is less than those of the individual bonds of the participating Länder, demonstrating the beneficial effect of enhanced liquidity and joint liability to the cost of borrowing.

We create a measure of liquidity of Länder bonds based on the law of one price. A standard measure of liquidity is the yield-spread between on-the-run and off-the-run bonds.⁷ Our comprehensive set of data allows us to generalize

⁶Dispersion is measured by the standard deviation and the interquartile range.

⁷Alternative measures include the bid/ask spread or the spread between government paper and agencies enjoying an explicit government guarantee (Longstaff 2004).

this simple measure and compute the yield variation between all bonds of a single issuer at one point in time. After adjusting for the term spread, these bonds should have identical yields. We attribute remaining differences to liquidity. The illiquidity measure L_i^t for bonds of Land i at time t is computed as the standard deviation of the yields of all bonds in the appropriate subset. We repeat this exercise for all maturity classes:

$$L_{i,t} = \text{std}\{r_{i,t}^j\}_{j=1}^n \quad \text{with} \quad (1)$$

$$r_{i,t}^j = y_{i,t}^j - (y_{Bund,t}^{ttm(j)} - y_{Bund,t}^l),$$

where $j = 1..n$ are the n bonds outstanding by issuer i at time t , which have a time to maturity $ttm(j)$ falling into the considered maturity class. Each bond's yield is corrected for the appropriate term spread, which is measured by the Bund yield curve, where superscript l denotes the lower end of the relevant maturity class (for example 4 years in the 4-7 year class).

Figures 13 and 14 plot the evolution of the so-computed liquidity measure for selected Länder. Over time, three Land-specific liquidity shocks can easily be identified. While the illiquidity spike for North Rhine Westphalia's bonds in November 1999 is caused by a change in the composition of the calculation portfolio, the spikes for Berlin in February 1996 and Baden-Wuerttemberg in March 1999 cannot easily be attributed to a single event. Interestingly, we find a common liquidity event at the start of the current financial turmoil in the summer of 2007. Later, bonds of the three Länder depicted tend to become more liquid again, possibly as the result of safe haven flows. A noteworthy fact is the moderate decrease in liquidity for North Rhine Westphalia's bonds (the largest Land) and the complete absence of an illiquidity spike for Jumbos, indicating the greater depth of the market.

3 Conclusions

This paper presents a comprehensive data set of the German sub-national government bond market since 1992. We document the quantitative evolution of this market, which is comparable in size to the German corporate bond market. Moreover, we compute yield to maturity time series at a daily frequency for all German Länder as a weighted average of traded bonds on a given day in a given maturity class. Finally, we also construct a measure of liquidity of government bonds.

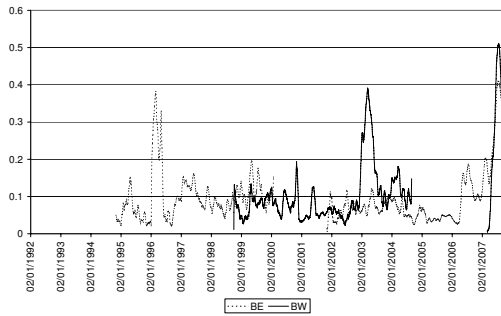


Figure 13: Liquidity measure for bonds of Berlin and Baden-Wuerttemberg (4-7 years time to maturity), standard deviation of yields of single bonds.

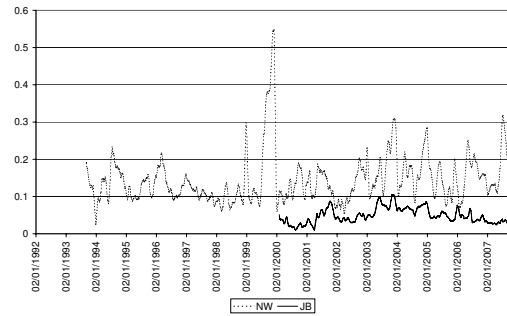


Figure 14: Liquidity measure for bonds of North Rhine Westphalia and Jumbos (4-7 years time to maturity), standard deviation of yields of single bonds.

The new data set of daily yields of all German Länder can be used for further studies. The data allow to perform event studies of important changes in the German federation. For example, they could be used to assess the effects of important constitutional court rulings, which potentially impact on the financial situation of Länder, such as the recent ruling on additional fiscal transfers for the Land Berlin. It could also be used to study effects of European monetary integration on regional sovereign bond markets. Finally, reforms of the system of fiscal transfers across states and central government could be assessed by studying risk premia in the market.

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A Appendix

Table 1: Abbreviations of Länder names

code	English	Deutsch
BB	Brandenburg	Brandenburg
BE	Berlin	Berlin
BW	Baden-Wuerttemberg	Baden-Württemberg
BY	Bavaria	Bayern
HB	Bremen	Hansestadt Bremen
HE	Hesse	Hessen
HH	Hamburg	Hansestadt Hamburg
MV	Mecklenburg-Western Pomerania	Mecklenburg-Vorpommern
NI	Lower Saxony	Niedersachsen
NW	North Rhine Westphalia	Nordrhein-Westfalen
RP	Rhineland-Palatinate	Rheinland-Pfalz
SD	Saarland	Saarland
SH	Schleswig-Holstein	Schleswig-Holstein
SN	Saxony	Sachsen
ST	Saxony-Anhalt	Sachsen-Anhalt
TH	Thuringia	Thüringen

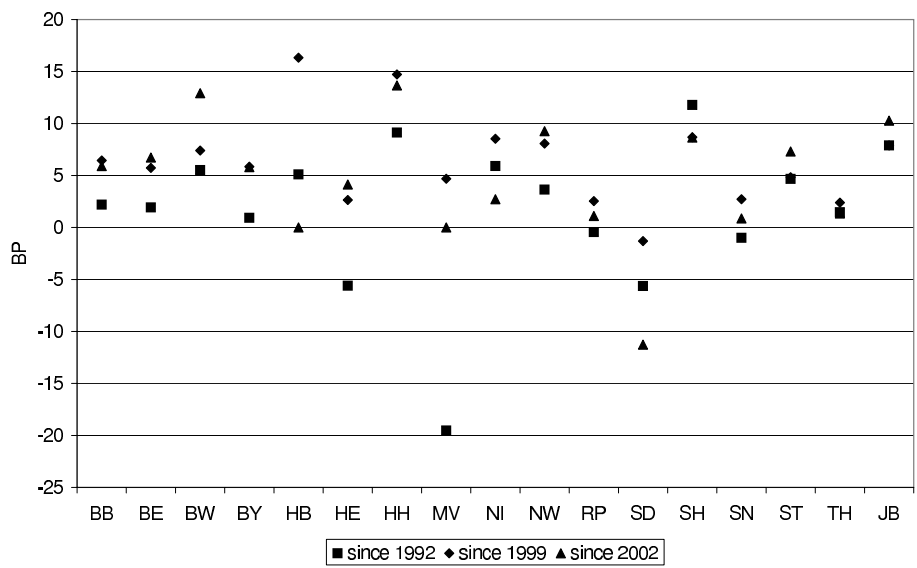


Figure A-1: Averages of spreads between Öffentliche Pfandbriefe (Public Pfandbriefe) and Länder bonds. Maturity class 4-7 years, basis points.

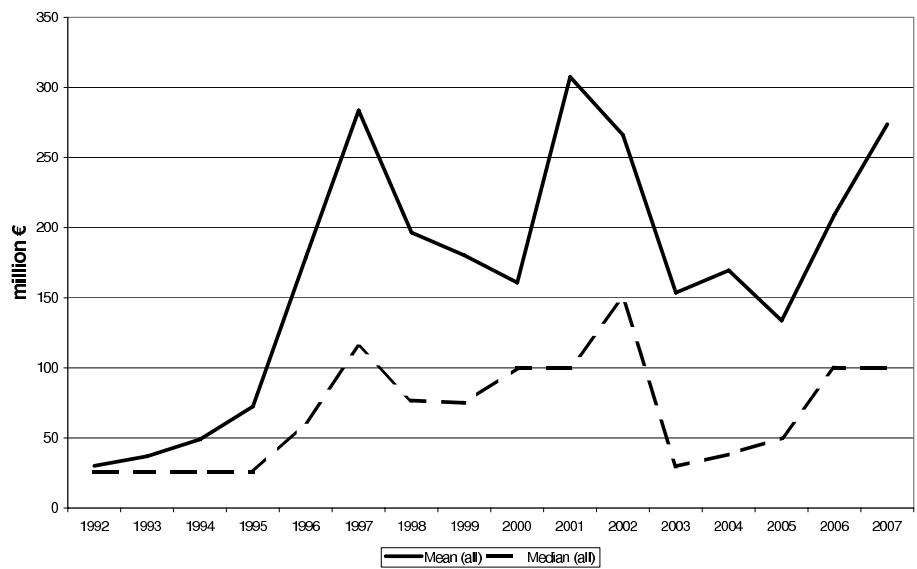


Figure A-2: Evolution of mean and median issue size of all Länder 1992Q1-2007Q3.

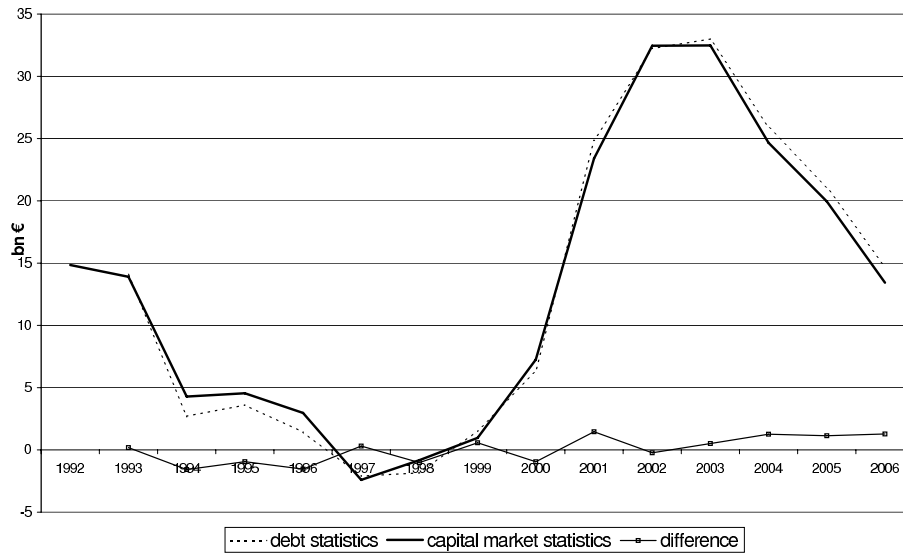


Figure A-3: Annual changes in net debt of Länder in capital markets. Figure compares data from debt statistics (Schulden der öffentlichen Haushalte, Fachserie 14 Reihe 5, Veränderung der Wertpapiersschulden) and capital market statistics (Brutto-Absatz inländischen Inhaberschuldverschreibungen zu Nominalwerten von Anleihen der öffentlichen Hand nur Emissionen der Länder insgesamt - Tilgung von Anleihen der öffentlichen Hand nur Bundesländer insgesamt).

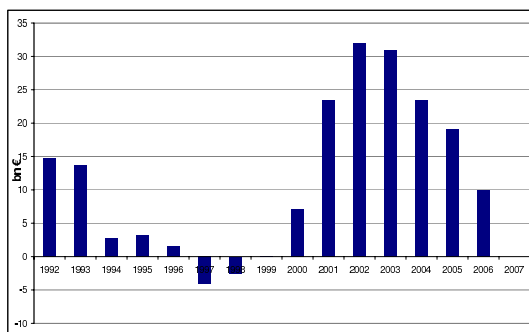


Figure A-4: Net issue-volume per year. "Net" is calculated as the gross figure less the re-payment (Schuldentilgung) of bond debt according to the debt statistics of Statistische Bundesamt.

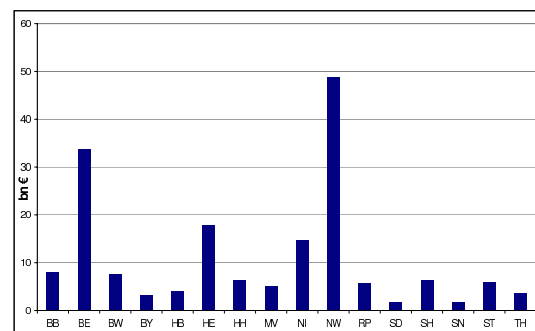


Figure A-5: Net issue-volume per Land.

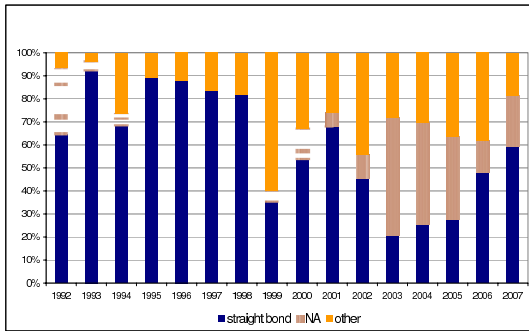


Figure A-6: Type per year for all Länder.

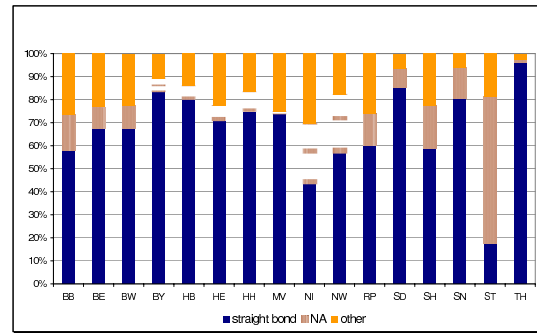


Figure A-7: Type per German Land during 1992-2007Q2.

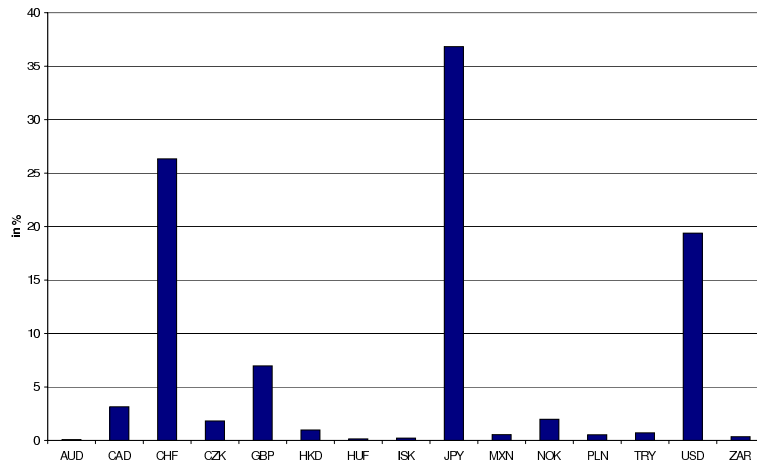


Figure A-8: Foreign currency breakdown of all Länder issues 1999Q1-2007Q3.

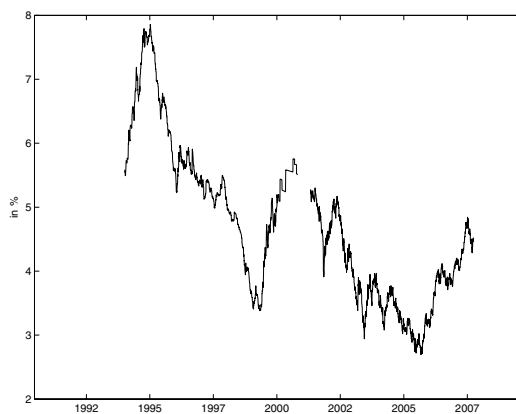


Figure A-9: Yield to maturity, 4-7 years, State Brandenburg

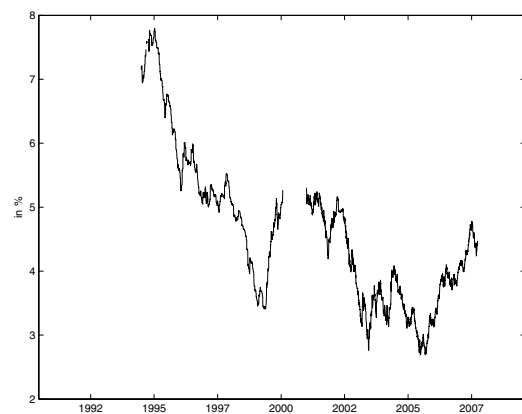


Figure A-10: Yield to maturity, 4-7 years, State Berlin

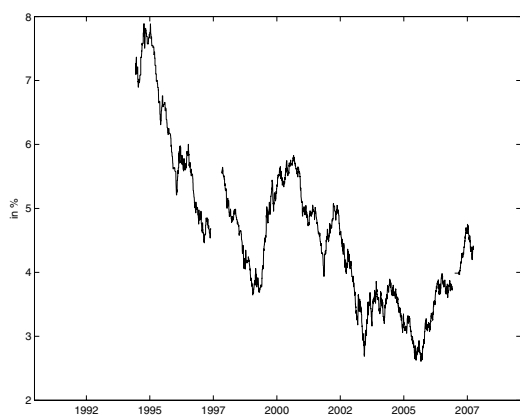


Figure A-11: Yield to maturity, 4-7 years, State Baden-Wuerttemberg

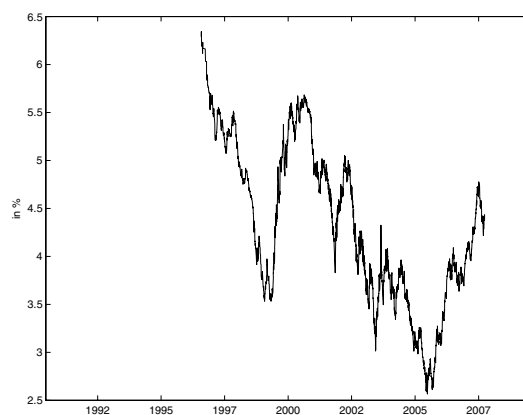


Figure A-12: Yield to maturity, 4-7 years, State Bavaria

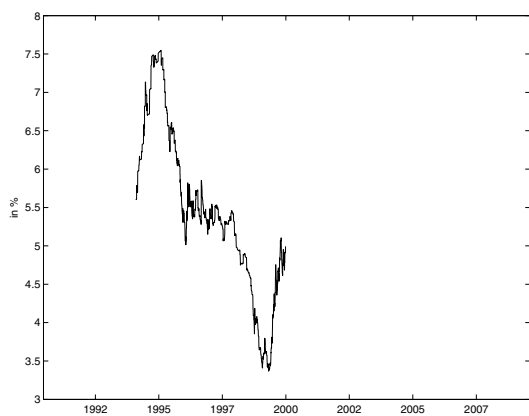


Figure A-13: Yield to maturity, 4-7 years, State Bremen

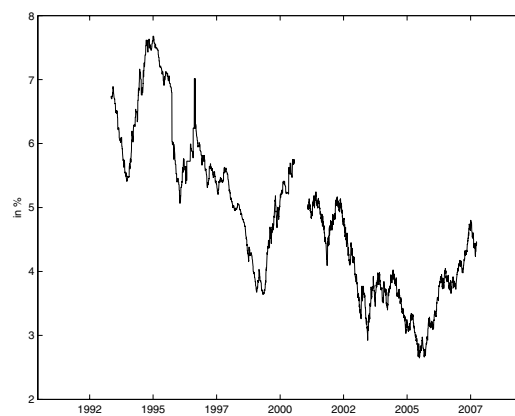


Figure A-14: Yield to maturity, 4-7 years, State Hesse

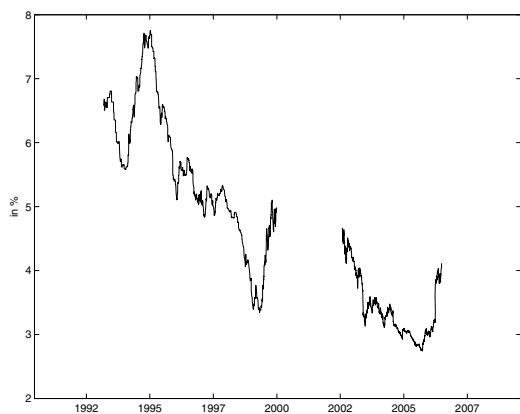


Figure A-15: Yield to maturity, 4-7 years, State Hamburg

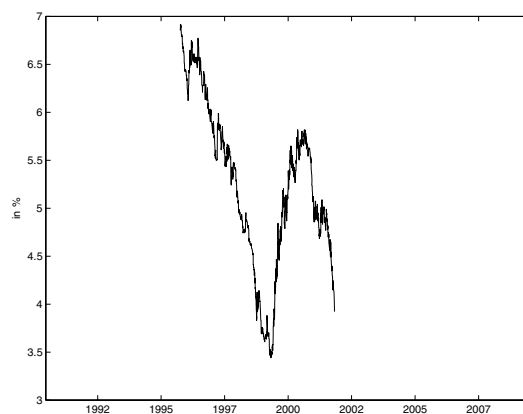


Figure A-16: Yield to maturity, 4-7 years, State Mecklenburg-Western Pomerania

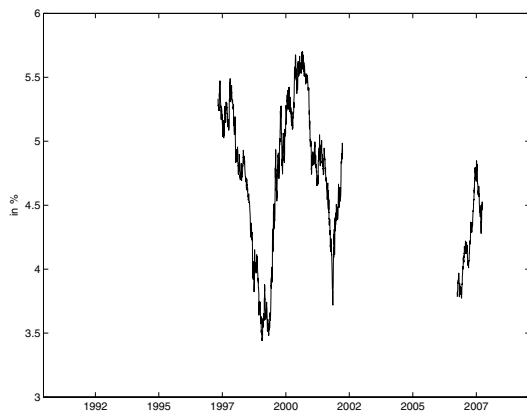


Figure A-17: Yield to maturity, 4-7 years, State Lower Saxony

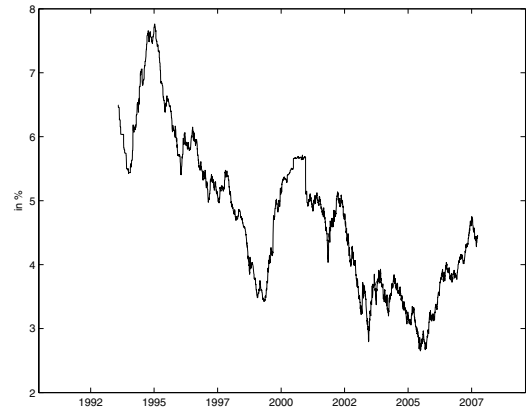


Figure A-18: Yield to maturity, 4-7 years, State North Rhine Westphalia

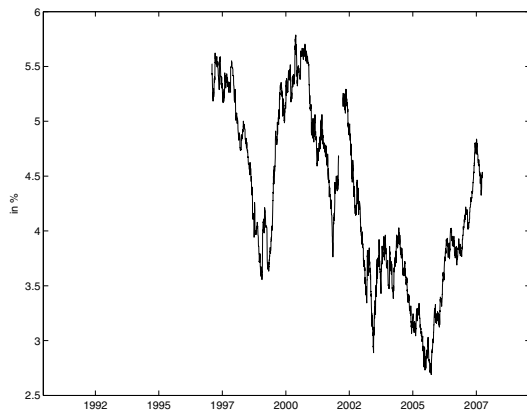


Figure A-19: Yield to maturity, 4-7 years, State Rhineland-Palatinate

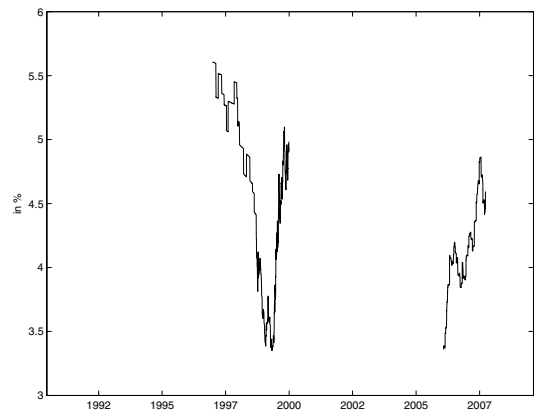


Figure A-20: Yield to maturity, 4-7 years, State Saarland

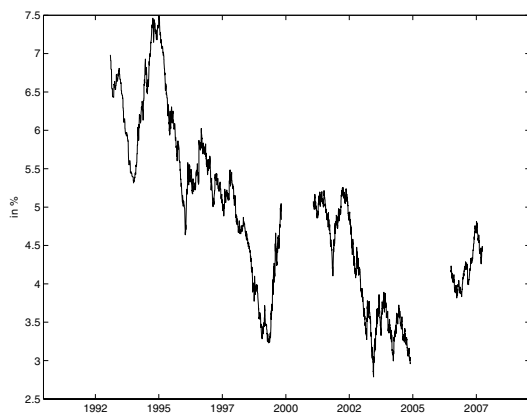


Figure A-21: Yield to maturity, 4-7 years, State Schleswig-Holstein

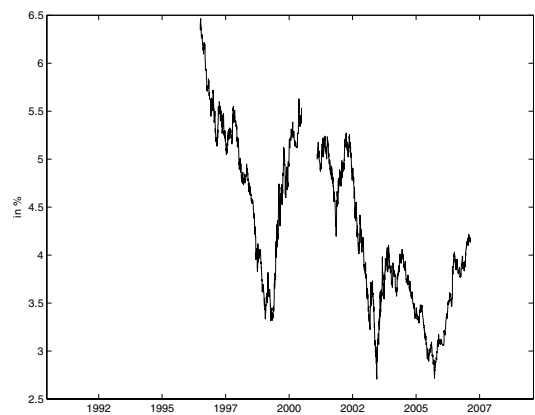


Figure A-22: Yield to maturity, 4-7 years, State Sachsen

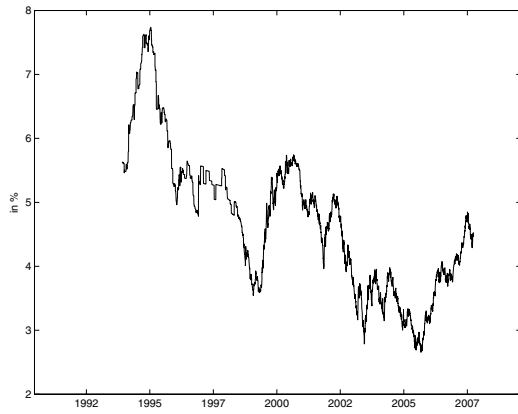


Figure A-23: Yield to maturity, 4-7 years, State Saxony-Anhalt

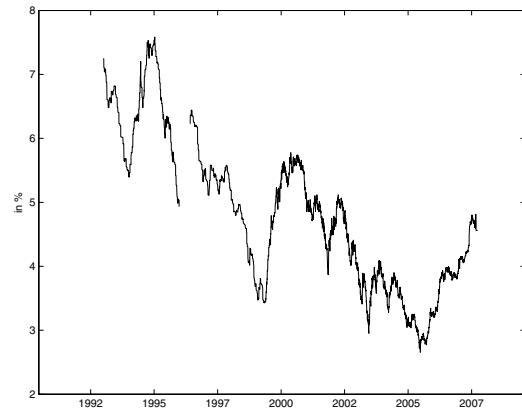


Figure A-24: Yield to maturity, 4-7 years, State Thuringia

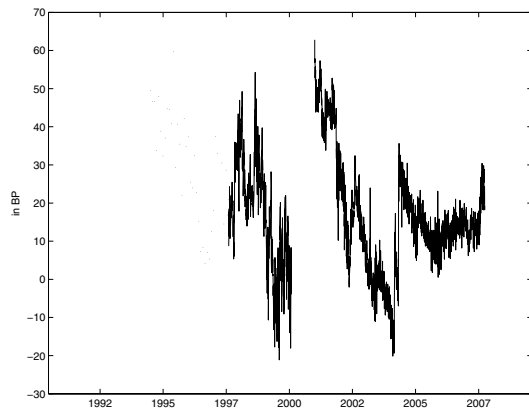


Figure A-25: Yieldspread Berlin vs. Bund, maturity class 4-7 years, Bund yield measured by the par yield curve, source: Deutsche Bundesbank.

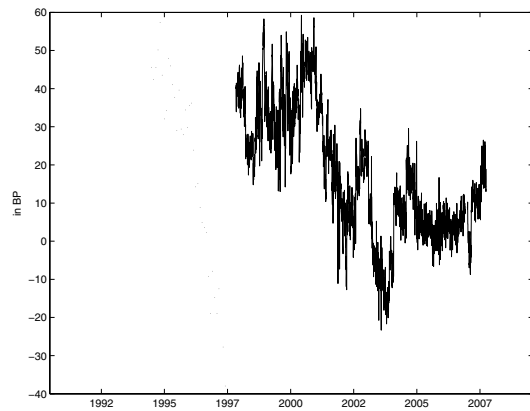


Figure A-26: Yieldspread Baden-Wuerttemberg vs. Bund, maturity class 4-7 years, Bund yield measured by the par yield curve, source: Deutsche Bundesbank.

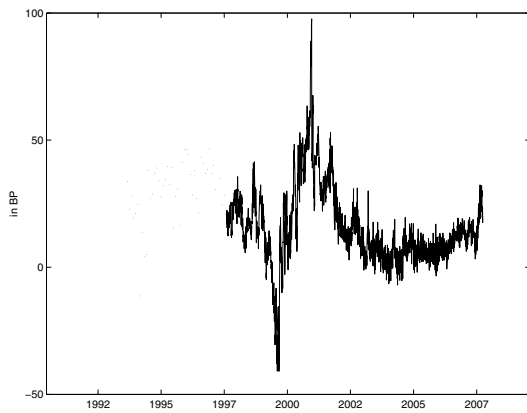


Figure A-27: Yieldspread North Rhine Westphalia vs. Bund, maturity class 4-7 years, Bund yield measured by the par yield curve, source: Deutsche Bundesbank.

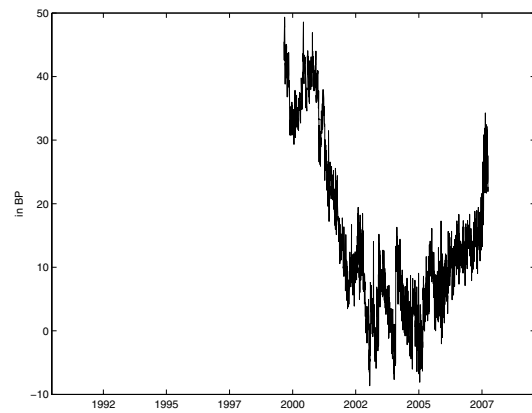


Figure A-28: Yieldspread Jumbos vs. Bund, maturity class 4-7 years, Bund yield measured by the par yield curve, source: Deutsche Bundesbank.

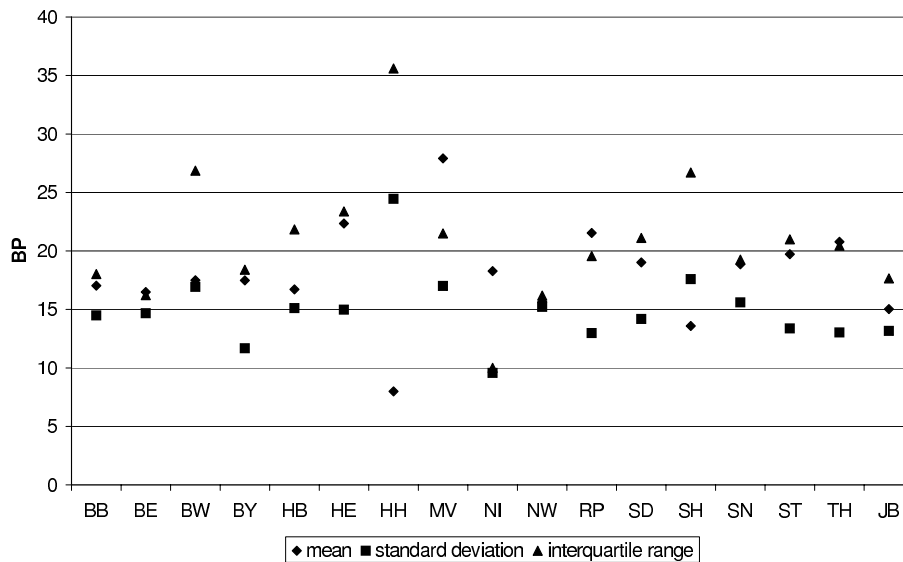


Figure A-29: Descriptive statistics of Bund/Länder spreads.

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