

The market for federal state bonds*

Since reunification, the German federal states have become considerably more indebted. Since the end of the 1990s, however, an increasing number of federal state bonds have been issued to finance budgetary deficits, and since 2001, loans from domestic banks have been repaid. Yet few analyses of the market for federal state bonds have been conducted. This article therefore starts by outlining market developments within the context of changes in federal state budgets and debt. Issue strategies vary, both over time and from one federal state to another. These variations include the volume of bonds issued, degree of structuring and tradability on the secondary market.

Based on an internal dataset, the article then moves on to examine how the yields on bonds of all 16 federal states have developed. Here, a gradual decline in the yield spread between federal state bonds and central government bonds (Bunds) has been observed since 2000. Furthermore, the co-movement in yields is increasing. This phenomenon can be explained to a large extent by the increasing amount of liquidity on the market for federal state bonds.

* To avoid confusion, bonds or other securities issued by any of the 16 federal states which form the Federal Republic of Germany are referred to as *federal state* instruments throughout this article. Bonds or other securities issued by the Federal Government are referred to as *central government* paper. Bonds or other securities issued by governments in other countries are referred to as bonds.

Development of federal state debt

*Federal state
debt varies
greatly*

Between the end of 1992 – when comparable results were first available for the whole of Germany – and the end of 2007, the credit market debt of the federal states rose from the Deutsche Mark equivalent of €196 billion¹ to €482 billion.² Developments varied from federal state to federal state. Debt increased substantially, above all, in the new federal states, which financed their – initially relatively debt-free – budgets to a large extent by raising loans, especially in the years immediately after reunification. At an average of €5,600 per inhabitant, the credit market debt in these federal states exceeded the level of the federal states in western Germany. At almost €13,500, however, the absolute increase was strongest in Berlin in this period, while an increase of only €500 or so per inhabitant was recorded in Bavaria. The highest per capita debt level – almost €22,000 – was reported in Bremen at the end of last year. Debt was therefore more than seven times as high in Bremen as it was in Bavaria (including local government). Yet there were also marked differences between the non-city federal states. At the last count, the per capita credit market debt of the federal states of Saarland and Saxony-Anhalt was more than four and a half times as high as that of Bavaria.

*Tax revenue
and fiscal
deficit*

There were a number of reasons for the large federal state deficits in the years subsequent to reunification. In the old federal states, they resulted mainly from tax shortfalls owing to tax relief following the third stage of the income tax reform in 1990, payments for the

benefit of the new federal states and a sharp rise in other expenditure in 1991 and 1992. In the new federal states with their extremely narrow tax base, the additional transfer payments in these years were not nearly sufficient to cover expenditure. The federal states' efforts to curb expenditure growth from 1993 did not lead to the intended deficit reduction owing to a – partly cyclical – decline in revenue. Net new borrowing did not fall significantly until 1997 and lasted until 2000. This was attributable to expenditure restraint as well as the substantial rise in revenue, particularly from profit-related taxes. While growth in federal state expenditure had averaged more than 5% per year at the beginning of the 1990s, it rose by no more than an average of 0.5% per year from 1997 to 2000.

From 2001, however, federal state net new borrowing again increased sharply, reaching a high of slightly more than €30 billion in 2003. The significant increase in debt was accompanied by weak revenue growth, which fell by 8% overall or €14 billion from 2001 to 2003 and increased only slightly in 2004 and 2005. This was chiefly attributable to profit-related taxes, the decrease in which can only be partially explained by statutory tax relief and restrained macroeconomic development. Overall, these factors led to a €4 billion decrease in federal state income in 2005 com-

¹ Credit market debt comprises loans and security debts. Amounts have been converted into euro at the official conversion rate.

² See Deutsche Bundesbank, State government finances in Germany, Monthly Report, July 2006, pp 29-50 and Deutsche Bundesbank, Trends in Länder Government finance since the mid-nineties, Monthly Report, June 2001, pp 57-74.

pared with 2000. Increased expenditure also clearly led to increased deficits and thus new borrowing in this period. Averaging 1% annually between 2000 and 2005, the increase was limited, however.

In the last two years, the overall fiscal deficit of the federal states was completely eliminated, and the first surplus since 1969 (€9 billion) was actually recorded in 2007. This was due mainly to proceeds from asset sales and strong growth, particularly in volatile profit-related tax revenue as well as the additional revenue arising from the increase in the standard rate of VAT in 2007. Another contributory factor was that expenditure continued to increase at a relatively restrained average annual rate of 1¼%. Yet, despite the large surplus overall, some federal states still had to borrow – in some cases, quite extensively – to finance their budgets last year.

Capital market debt and bank loans

Bonds play increasingly significant role in lending

Traditionally, the German federal states have financed their budget deficits extensively through bank loans. The high federal state deficits after reunification therefore also led to a sharp increase in liabilities to domestic credit institutions (see the chart on page 34). At the end of 1997, these amounted to €235 billion compared with €147 billion at the beginning of 1992.³ The subsequent consolidation and reduction in the federal state deficits temporarily led to a significantly slower increase in 1998 and 1999, however. A basic change can be observed in the weighting of the federal states' financial in-

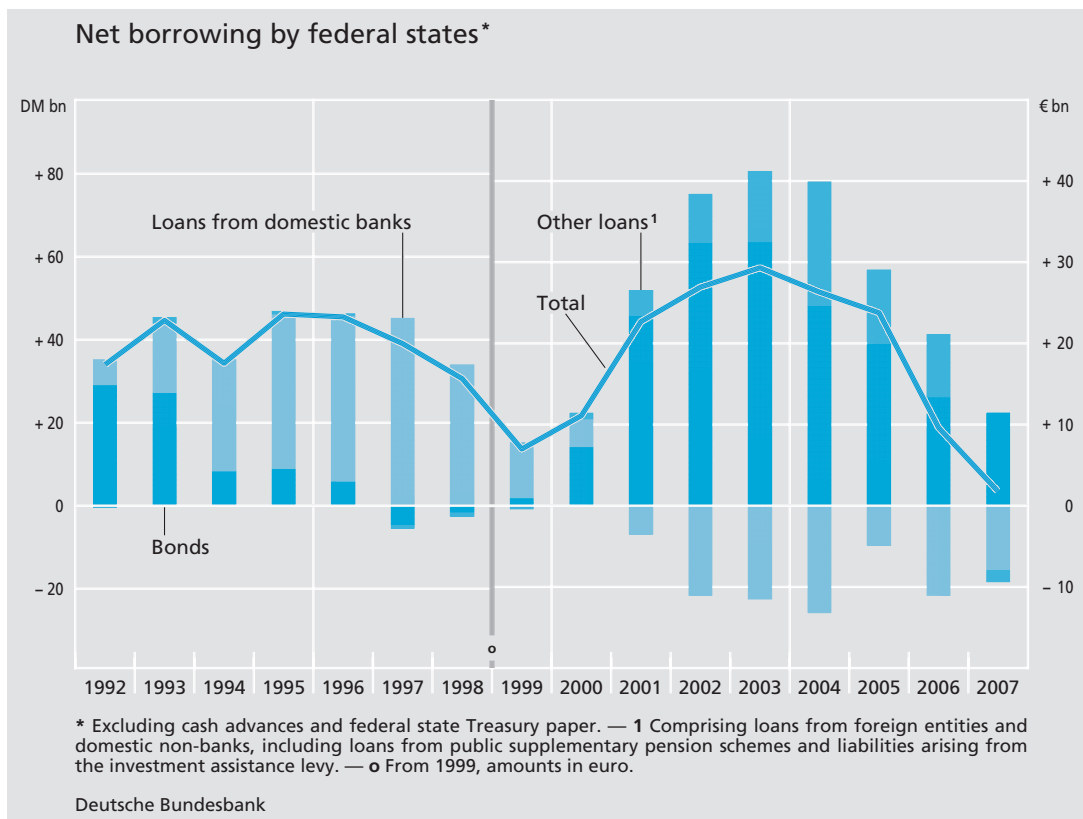
struments for financing the renewed increase in fiscal deficits as of 2000. Given the general broadening and deepening of financial markets, replacing bank loans with the issue of own bonds on the capital market became advantageous for the federal states.⁴ The gross issue volume of federal state bonds therefore surged accordingly. As a result, fewer bank loans were raised, and existing loans were actually repaid on a net basis from the end of 2001. Owing to increased issuance activity, the federal states started to play a greater role in the German capital market. In the period from 1992 to 1999, the federal states accounted for slightly more than 3% of net sales⁵ of debt securities on the German bond market; between 2000 and 2007, by contrast, the federal states accounted for 16% of net sales.⁶ At the end of 2007, the total volume of federal state bonds outstanding was €228 billion compared with an outstanding volume of €938 billion in the case of central government securities. Debt securities therefore account for 47% of overall federal state debt compared with 96% in the case of the Federal Government.

³ Excluding cash advances.

⁴ The yield spread on public Pfandbriefe and federal state bonds widened from 1999. Since yields on public Pfandbriefe determine the banks' refinancing costs for public sector loans, they can be used to estimate the lending rate.

⁵ Gross issue volume less repayments.

⁶ Data on new issuance of debt securities are taken from the Bundesbank's issuance statistics.



Volume and structure of federal state bonds

Issuance activity up considerably since 2000

Between 1992 and 2007, the German federal states issued a total of more than 2,800 different bonds, some of which have been topped up over time.⁷ At just under 90%, by far the largest share of gross sales was attributable to securities with an original maturity of more than one year.

The most populated federal state, North Rhine-Westphalia, is also by far the leading issuer of federal state debt securities on the market; it issued bonds with a value of €102 billion from 1992 to 2007. Berlin's particular debt problem is reflected in its gross sales of just under €58 billion in this period. Together with Lower Saxony, the considerably

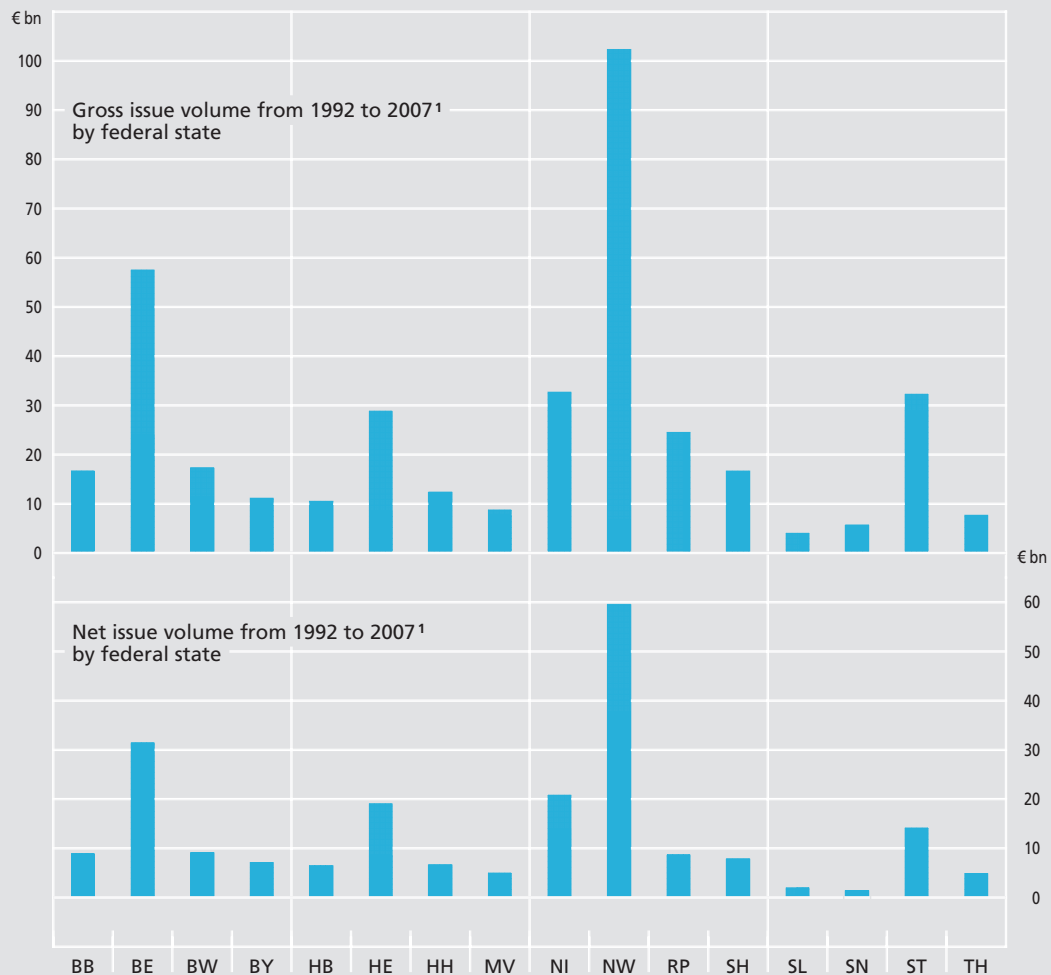
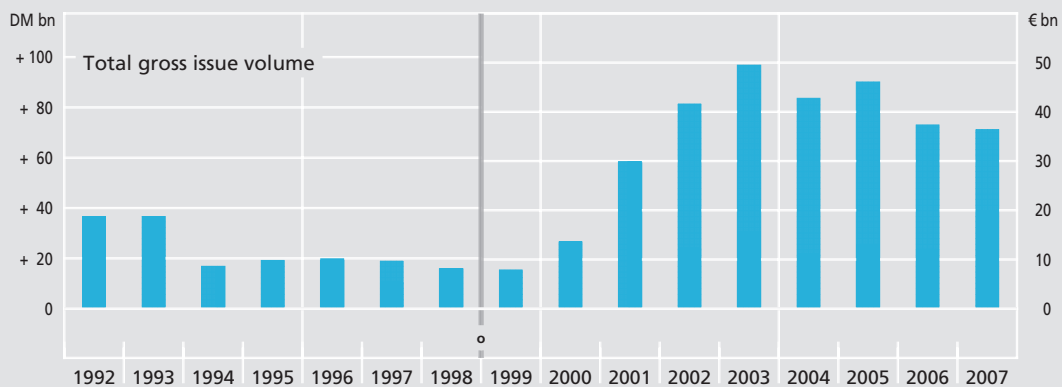
smaller state of Saxony-Anhalt is one of the biggest issuers in the bond market (around €32 billion each). A similar picture can be seen after the deduction of repayments. North Rhine-Westphalia raised just under €60 billion net on the capital market between 1992 and 2007, followed by Berlin (just over €31 billion), Lower Saxony (just under €21 billion) and Hesse (just over €19 billion). See the chart on page 35).

The federal states sell their bonds to two different investor groups. First, bonds are placed privately, ie sold to long-term investors who usually retain the security until maturity.

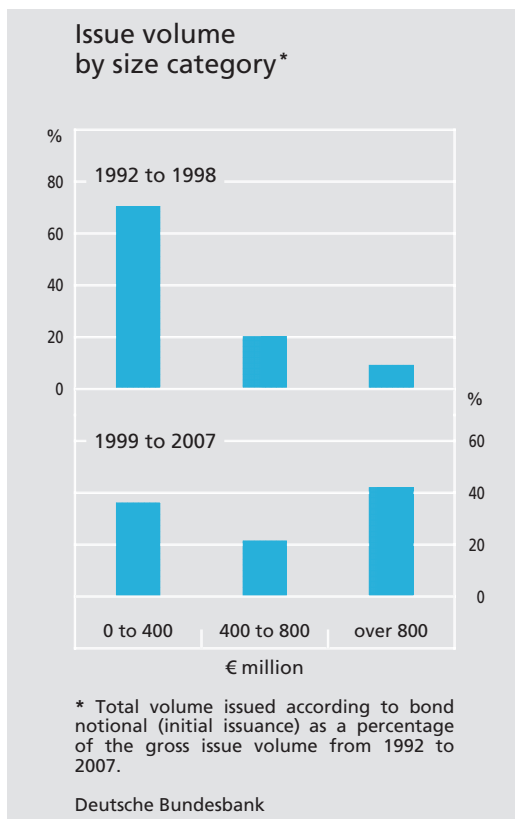
Stronger issuance of large-volume bonds ...

⁷ See also Schulz and Wolff: The German sub-national government bond market: evolution, yields and liquidity, Deutsche Bundesbank Research Centre, Discussion Paper, Series 1, No 06/2008.

Federal state bonds *



* State abbreviations: BB=Brandenburg; BE=Berlin; BW=Baden-Württemberg; BY=Bavaria; HB=Bremen; HE=Hesse; HH=Hamburg; MV=Mecklenburg-Western Pomerania; NI=Lower Saxony; NW=North Rhine-Westphalia; RP=Rhineland-Palatinate; SH=Schleswig-Holstein; SL=Saarland; SN=Saxony; ST=Saxony-Anhalt; TH=Thuringia. — o From 1999, amounts in euro. — 1 Up to 1999, amounts converted into euro at the official rate.



Second, securities are issued with secondary trading in mind. The latter usually have a higher issuing volume, carry a fixed coupon and are repaid on a specific date. From the issuer's perspective, bonds sold to private investors have the advantage that they can be tailored to the needs of a particular target group. The disadvantage is that investors demand a higher liquidity premium for non-marketable securities.⁸ Unlike the federal states, the Federal Government meets its capital market borrowing needs almost exclusively with marketable bonds.⁹ Between 1992 and 1998, 70% of the federal states' bond sales were attributable to bonds with a respective issue amount of less than €400 million upon initial issuance. This percentage halved in the period between 1999 and 2007 (see above chart) to the benefit of large-

volume securities. Nonetheless, the bulk of issues continued to have relatively low volumes after 1999. Moreover, issuance policy clearly varies from federal state to federal state. While 84% of all bonds issued in Lower Saxony had an issue volume of more than €400 million in the period from 1992 to 2007, Saxony preferred smaller securities and raised 91% of its capital in this way.

... but majority of issues still small

For smaller federal states, in particular, issuing large-volume bonds is not always optimal, despite the generally lower liquidity premium. In view of their predominantly low borrowing needs in absolute terms, these federal states very rarely had to become active in the capital market, but did have to invest or raise funds in the money market between issue dates. In order to issue large-volume bonds without incurring these additional liquidity holding costs, a number of federal states have joined forces to offer joint Jumbo bonds since 1996 ("federal state Jumbos"). From an investor's perspective, Jumbo bonds not only provide a higher degree of liquidity but also mean that the federal states involved are jointly and severally liable. Jumbo bonds have an average issue volume of just over €1.2 billion and are therefore some of the largest bonds in the market for federal state bonds. By way of comparison, however, central government issues are still much larger. The average vol-

"Jumbos" – joint bonds of the federal states

⁸ The liquidity premium is a markdown which mitigates the risk of not being able to sell a particular amount of a bond on a particular date without influencing the prevailing market price. With non-marketable securities, illiquidity is, by definition, high.

⁹ To a relatively limited extent, the Federal Government issues savings notes. These are offered primarily to individuals and not permitted for trading on the stock exchange, but can be returned to the Federal Government prior to maturity subject to certain conditions.

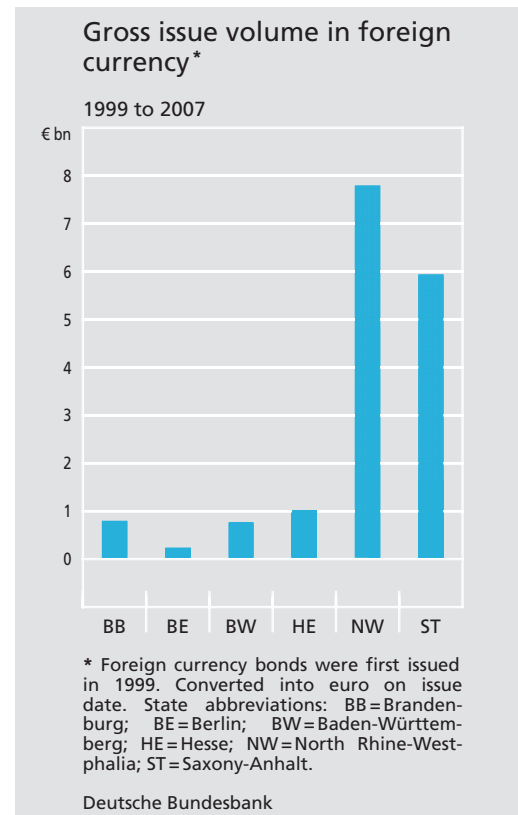
ume of central government bonds and five-year Federal notes, including top-ups, is around €15 billion and €9 billion, respectively. "Federal state Jumbos" are used mainly by Bremen, Hamburg, Mecklenburg-West Pomerania, Saarland, Schleswig-Holstein and Thuringia, which raised between just under 40% and just over 75% of their capital on the bond market by means of Jumbos.¹⁰ Rhineland-Palatinate also participates in Jumbo bonds on a regular basis, but these account only for a smaller percentage of its capital market borrowing (just over 20%). Some other federal states have, at least to some extent, taken part in the issuance of Jumbos for a limited period.¹¹

Structured debt securities

An important feature of debt securities is their structure. While the Federal Government finances its debts primarily by means of straight bonds, ie securities with a fixed term and fixed coupon,¹² the federal states make use of more complex financial products – usually lower-volume bonds. Variable interest rates coupled with market rates such as the Euribor are very common. In contrast to central government securities, federal state bonds also offer debtors or creditors termination options. Furthermore, some federal states also issue "exotic" bonds.¹³

Foreign currency bonds

Since 1999, the federal states have also borrowed money in foreign currency. Since then, the average issue volume in foreign currency has been 5½%. From a legal perspective, however, there is usually little leeway in terms of exchange rate risks. They normally have to be completely hedged.¹⁴ To date, six federal states have issued non-euro debt securities.



¹⁰ Since the first Jumbo was issued in 1996 until the end of 2007.

¹¹ Brandenburg, Berlin, Hesse, North Rhine-Westphalia and Saxony-Anhalt.

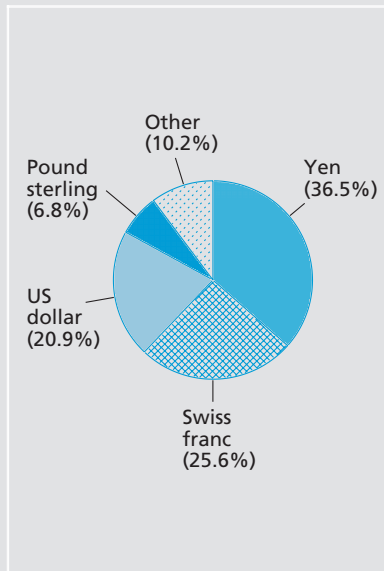
¹² The Federal Government currently has two structured bonds outstanding which are inflation-indexed.

¹³ These include a bond issued by Saxony-Anhalt pursuant to Islamic law and a debt security issued by Brandenburg and indexed to the oil price.

¹⁴ For example, the 2005-2006 Budget Act of Saxony-Anhalt stipulates that currency risks must generally be hedged. In exceptional circumstances, the finance ministry can deviate from this rule; it maintains that it does not make use of this option, however. If covered interest rate parity holds, by which an arbitrage relationship between interest rates in different currency areas and changes in exchange rates is assumed, raising capital in a foreign currency while hedging the foreign currency exposure will not result in financial advantage. Constellations may, however, arise on the foreign exchange and swap markets which create more favourable (or unfavourable) conditions for raising funds in foreign currency. See Baba, Packer and Nagano, The spillover of money market turbulence to FX swap and cross-currency swap markets, Bank for International Settlements, Quarterly Review, March 2008. This clearly places greater demands on public debt administration, and central government activities are plainly less transparent as a result.

Individual currencies' percentage share of total gross issue volume of foreign currency bonds

1999 to 2007



Deutsche Bundesbank

The largest issuer was again North Rhine-Westphalia (just under €8 billion gross) followed by Saxony-Anhalt (just under €6 billion gross). In relation to funding on the capital market, however, Saxony-Anhalt makes the most intensive use of this type of bond. Between 1999 and 2007, Saxony-Anhalt raised more than one-quarter of its issue volume in foreign currency, followed by North Rhine-Westphalia (just under 10%). Brandenburg, Baden-Württemberg, Hesse and, to a lesser extent, Berlin also raised capital in this way (see the chart on page 37). In total, the federal states issued bonds in 15 foreign currencies. In terms of value, the largest share is attributable to traditionally low-interest-bearing currencies such as the yen and the Swiss franc, which account for just over one-third and over one-quarter, respectively, of capital

raised in foreign currency. The US dollar (approximately one-fifth) is also a popular currency for debt securities, as is, to a lesser extent, the British pound (just under 7%). See the adjacent chart.

Yields and liquidity

Not only volume and structure but also price factors play a crucial role in the market analysis of federal state bonds. Since there are no relevant indices, time series are calculated for the average bond yields of each federal state. These are then compared with the yields on central government bonds. Finally, the factors which influence the interest rate differential between central government and federal state bonds are examined.

Only bonds denominated in Deutsche Mark or euro which have a fixed coupon and are repaid on a specific date – in other words, not subject to termination rights – are factored into yield calculations. These limitations make it possible to depict a comparatively homogeneous market segment, which demonstrates characteristics similar to those of central government bonds. Of the 2,864 federal state debt securities issued since 1992, 1,800 fulfil the above-mentioned criteria. The relatively low issue volume, particularly in the 1990s, complicates the calculation of yields for all maturities, however. Bonds are therefore sub-divided into four categories at any given time by residual maturity: up to four years, four to less than seven years, seven to

Yields on federal state bonds

less than 11 years and more than 11 years.¹⁵ The federal states prefer to issue bonds with a maturity of four to seven years (around 40% of the issue volume), followed by the seven to 11 year category (just over 35%). The following presentation of yields relates to bonds with a residual maturity of four to seven years, ie the most liquid category.

The yield on federal state bonds is calculated as an average of the bonds outstanding on the calculation date, the residual maturity of which falls into the relevant category. The yields on the bonds included in the average are weighted according to their respective outstanding volume. The yields on individual issues are taken from Thomson Financial Datastream. The chart on page 40 illustrates how yields have developed for three federal states as well as for Jumbo bonds issued jointly by several states.

*Yield spread
vis-à-vis central
government
bonds*

Changes in the yield spread vis-à-vis central government bonds of comparable maturity are of particular interest as fluctuations caused by general interest rate developments are eliminated from the equation in this way (see the chart on page 40).¹⁶ In the mid-1990s, when the issuance activity of federal states was generally very restrained, the annual average of this spread across all federal states amounted to more than 30 basis points. It narrowed significantly after 2001 and fell below 10 basis points at one point. The spread narrowed during a phase in which the federal states issued more bonds and risk premiums fell generally. The spread for particularly large-volume Jumbo bonds frequently fell below the average interest rate pre-

mium on all federal state bonds. Owing to the turbulence on the financial markets, the premium rose considerably in 2007 and, at an annual average of 21 basis points, was almost twice as high on the year, however. The rise in the interest rate premium for federal state bonds remained below that of Pfandbriefe, which tripled on the year in 2007 to an average of just over 30 basis points.¹⁷

The outstanding bond volume of Berlin and North Rhine-Westphalia is comparable with that of some countries in the euro area.¹⁸ The interest rate premiums on bonds issued by these countries followed a development pattern similar to that of the federal states in question after the euro had been introduced. They initially fell from over 20 to just a few basis points and picked up again to just under 10 basis points, predominantly in 2007; the yield spread of both federal states' bonds compared with that of central government bonds rose to almost 30 basis points.

The development of spreads suggests that, in general, three factors determine the interest

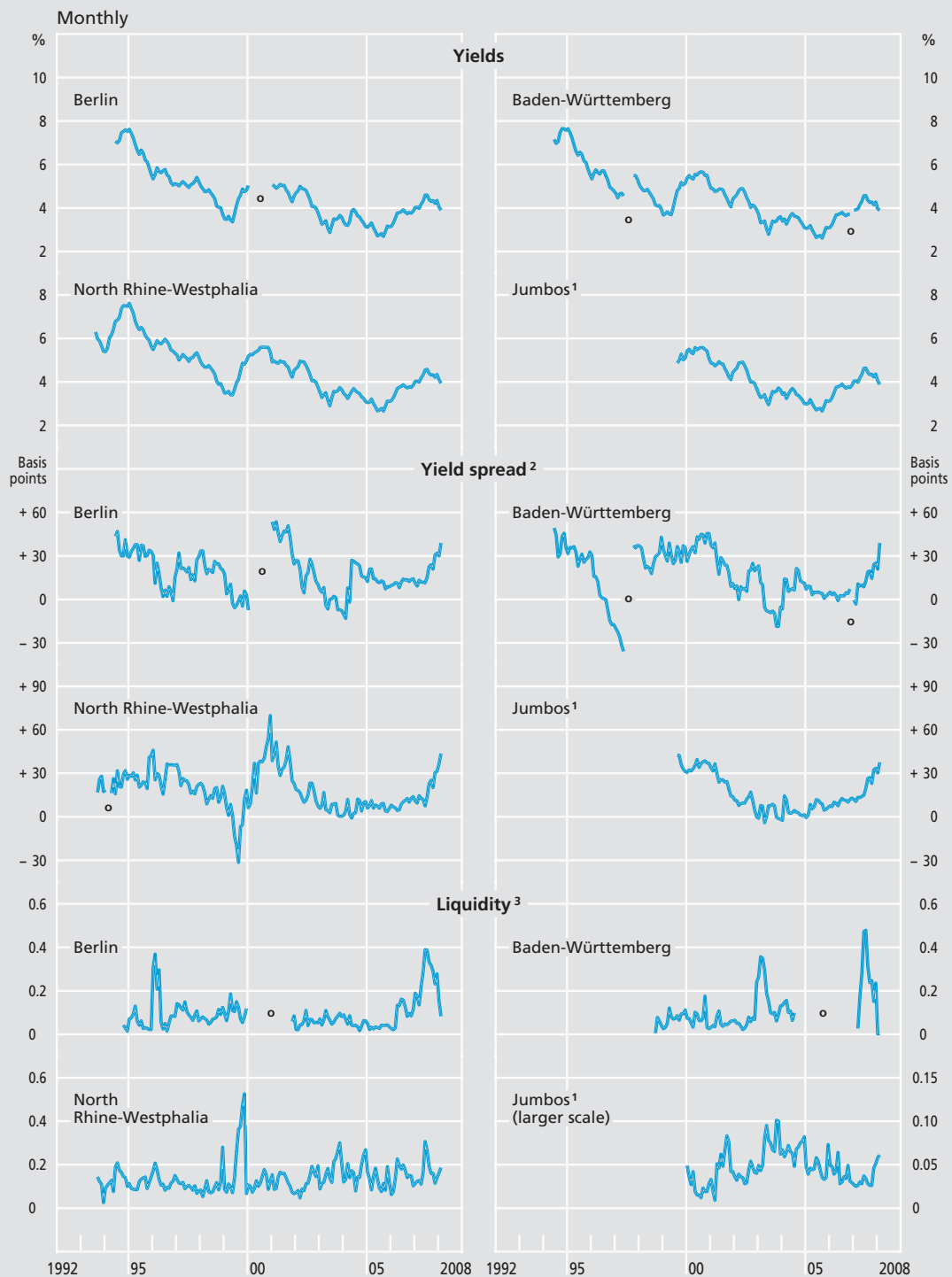
¹⁵ The maturity buckets are similar to those of wide-spread bond indices. The distribution of residual maturities in the category of four to seven years, which is in the focus of the analysis, does not change systematically over time.

¹⁶ When interpreting the interest rate differential of individual federal states, the – at times – low liquidity of the underlying bonds should be taken into account.

¹⁷ Average yield on central government bonds or Pfandbriefe with a maturity of four to seven years.

¹⁸ According to the Bank for International Settlements, Austria (€148 billion), Portugal (€120 billion), Finland (€88 billion) and Ireland (€39 billion) had bonds with outstanding volumes (each excluding money market paper) which were more or less comparable with the capital market debt of North Rhine-Westphalia (€62 billion) and Berlin (€33 billion). Contrary to those in the other analyses, these yield differentials relate to the most recent bonds issued with a maturity of around ten years.

Yields on and liquidity of federal state bonds*



* Bonds of selected federal states and Jumbo bonds with maturities of between four and seven years. — 1 Joint bonds of several federal states which have been issued since 1996. — 2 At the relevant federal state bond yield. — 3 Standard deviation of yields, adjusted for differences in maturity; the higher the value, the lower the liquidity. — o Discontinuity indicates that yields are not available for this period.

rate premium for federal state bonds compared with that of central government debt securities: liquidity premiums, the general willingness of investors to take risks and the specific risk which investors associate with bonds issued by individual federal states. While the risk propensity or aversion of the market is, for example, reflected roughly in the yield spread of corporate bonds to central government bonds, and federal-state-specific risks could result from higher debt, the empirical recording of federal state bond liquidity is more difficult.

*Liquidity of
federal state
bonds*

A market is perfectly liquid if, at a given time, any volume of a security can be traded on it without the price varying. There is, however, no exact measure of liquidity. Various techniques for measuring the liquidity of bond markets are presented in the literature. These can be broken down into two categories. Volume-based approaches record, for example, the outstanding volume of a bond or the trading volume. The outstanding volume of a debt security is usually known, but provides only very basic information on tradability. Trading volumes, on the other hand, relate directly to market activity. Since the majority of bonds are sold outside the stock exchange, however, this information is available only in exceptional cases.¹⁹ The second category comprises price-based measurements which can only be used for bonds which are actually traded; they therefore reflect only the more liquid part of the market *per se*.²⁰ An example of such a price-based indicator is the bid-ask spread, which, in the case of German central government bonds, tends to show little variation.²¹

Another option is to determine the heterogeneity of yields at a given time. In arbitrage-free markets, the same bonds have the same price or generate the same yield. Differences in the yields on securities of an issuer in a given maturity category are an indication of the bond having low liquidity as arbitrageurs would otherwise exploit the difference and prices would assimilate as a result.²²

One measure of the heterogeneity of federal state bonds is their standard deviation.²³ By observing this factor over time for individual federal states and Jumbo bonds, it becomes clear that large-volume Jumbo bonds are more liquid than the corresponding individual bonds of the federal states. This also applies during the third quarter of 2007, when illiquidity spikes were recorded for federal state bonds owing to the financial market turbulence (see the chart on page 40).

An empirical study on the determinants of federal state spreads shows that they are, in fact, determined mainly by liquidity premiums (see the explanatory notes on page 42). The higher the degree of liquidity of bonds issued

*Determinants
of federal state
spreads:
empirical
results*

¹⁹ Only around 2% of trade in central government bonds was conducted on stock exchanges in 2006. See Deutsche Bundesbank, Primary and secondary markets for German public sector debt instruments, Monthly Report, July 2007, pp 45-57.

²⁰ The majority of federal state debt securities are not traded.

²¹ See Deutsche Bundesbank, Current trends and structural changes in the public bond market, Monthly Report, October 2006, pp 29-44.

²² Alternatively, transaction costs can render the exploitation of obvious price differences unprofitable.

²³ Less standard deviation of yields on various bonds of a given federal state is a sign of a higher degree of liquidity. To take account of the various terms of the bonds used, the yields on federal state bonds were adjusted using the yield curve for central government bonds. See Schulz and Wolff (2008), *op cit*, p 7 ff.

Factors determining interest rate premiums of federal state bonds and central government bonds

Federal state bonds regularly have higher yields than the corresponding debt securities of central government. A possible reason for this could be the lower degree of liquidity of federal state bonds on the secondary market, for which investors demand a liquidity premium. In addition, investors could demand higher compensation for the possible default of federal state bonds (credit risk premium). Moreover, the spread should depend on the degree of general risk aversion, which is not directly observable. This risk aversion indicates the general propensity of investors to hold risky assets. In order to determine the influencing factors, the following panel regression is estimated with data on all 16 federal states.

$$spread_{it} = \alpha RAV_i + \beta illiquidity_{it} + \gamma debt_{it} + \mu_i + \varepsilon_{it}$$

The dependent variable is the difference in the yield between bonds with a maturity of four to seven years of federal state i and corresponding central government bonds at time t . The difference in the yield between US dollar-denominated corporate bonds of the lowest investment grade category (BBB) and US government bonds is used for measuring global risk aversion. The liquidity of federal state bonds is shown by means of the measure presented on page 41. A federal state's creditworthiness is measured by the per capita debt relative to that of the Federal Government. The heterogeneity between the federal states, which is not indicated by the other explanatory variables, is captured with a state-specific fixed-effects term μ . The estimate is made using daily data for the period between 1996 and 2006. The results are summarised in the adjacent table.

The results of regression A show that the spread between federal state bonds and central government bonds actually depends to a considerable degree on the risk aversion of investors. The more investors are afraid of risk, the higher compensations they demand for holding a debt security issued by a federal state rather than by the Federal Government. In turbulent times, it is therefore mainly central government paper that serves as a "safe haven". This could be a result of the higher degree of liquidity of central government bonds, ie an investor can sell a central government bond, without making a

1 For example, Bremen and Saarland received additional transfers between 1994 and 2004 to overcome extreme budgetary hardship. Following the Berlin ruling of autumn

loss on the prevailing market price, more easily than a corresponding federal state bond. This is taken into account in regression B, which, in addition to the risk aversion, also shows the concealed liquidity premium per se in the form of a positive coefficient: the lower the liquidity of federal state bonds, the greater the interest rate premium for central government bonds.

Regression C introduces per capita debt as a further explanatory variable. A higher debt should cause the credit risk of a federal state to rise. The estimated coefficient is statistically significant and exhibits the expected positive sign, testifying to the fact that the market actually demands a premium for the credit risk of a federal state. In economic terms, however, the effect is small: an increase of €1,000 in per capita debt relative to that of the Federal Government would increase the interest rate premium by no more than 1 basis point. This small reaction is due, first, to the high creditworthiness of German federal states, which is secured by future tax revenue and realisable assets. Second, the federal principle, which is seen not least in the state government revenue-sharing scheme, encourages an implicit joint responsibility with the other federal states and the Federal Government, at least in the eyes of market players.¹

Determinants of interest rate premiums

Item	A	B	C
Risk aversion	0.052 28.53	0.05 27.35	0.045 45.6
Illiquidity		18.892 28.39	19.571 27.68
Debt			0.001 5.94
N	37,549	31,598	29,423
R ²	0.021	0.044	0.043

Dependent variable: interest rate premium for bonds of federal state i in relation to corresponding central government bonds in basis points. Daily observations. Estimation period 1996 to 2006. The corresponding t-values are given below the coefficients.

2006, the requirements for this have been sharply tightened, but further help remains possible in the future in extreme circumstances.

by a federal state – measured by the standard deviation of yields – the lower the interest rate premiums themselves. The market players' general attitude to risk also plays a role. In times of lower risk propensity, investors demand a higher premium for holding federal state bonds. State-specific factors are also important. On the one hand, they manifest themselves as fixed effects for each federal state; on the other, investors with increasing per capita debt demand greater compensation from issuers. From an economic perspective, the latter effect is relatively slight, however. This is primarily a result of the federal principle and the assumed ultimate mutual assistance of central, state and local government.

Integration of the German market for domestic government bonds

The yield differential between federal state and central government bonds over time can also be explained from yet another perspective. The greater co-movement in yields on comparable securities can be an indication of increasing integration in the corresponding market. When the level of integration is high, events affecting the entire German bond market should be reflected in the yields of both central government and federal state bonds. An econometric estimate can determine the extent to which this is actually true. The resulting estimation parameters can be used to measure the level of integration (see also the explanatory notes on page 44 f).

Empirical results

As expected, the level of integration in the German market for domestic government bonds has been shown to increase significantly over time. Changes in yields on Bunds towards the end of the period under review

were reflected in the co-movement in federal state bond yields to double the extent they had been at the beginning of the 1990s. Market integration is not complete, however – the corresponding coefficient is 0.7 to 0.8 and not 1. This is probably due to persisting liquidity differences. This hypothesis is supported by the fact that the joint Jumbo bonds issued by several federal states, which are significantly more liquid owing to their higher issue volume, have a much larger integration level.

Owing to the turbulence on the financial markets, however, the integration levels of federal state bonds and Jumbos again fell somewhat. Investors evidently preferred the more liquid central government securities during these "troubled times". A similar development could also be seen in the relationship between Bunds and the equivalent government securities of other euro-area countries.

Summary and conclusions

Faced with mounting debt, the German federal states have increasingly been raising capital through the issue of bonds since the end of the 1990s; by contrast, fewer and fewer bank loans have been raised. Furthermore, the federal states have tended to opt for relatively large-volume bonds. In addition, joint bonds (Jumbos) with large issue volumes have been issued by several federal states since 1996, but have not reached the scale of central government bonds and five-year notes. Yet regardless of this trend, the over-

Integration of the German government bond market

The relationship between bonds issued by Germany's Federal Government and those issued by the country's state governments can be characterised *inter alia* by their degree of co-movement. The German market for domestic government bonds can be described as integrated if substitutable debt securities return the same yield.¹ Central government bonds (Bunds) are the benchmark for the German – as well as the European – bond market. One can assume that any news affecting the market as a whole will be reflected in the movements of Bund yields. In a perfectly integrated market, yields on Bunds and other bonds should therefore move in line with one another. This relationship can be estimated using the following approach:²

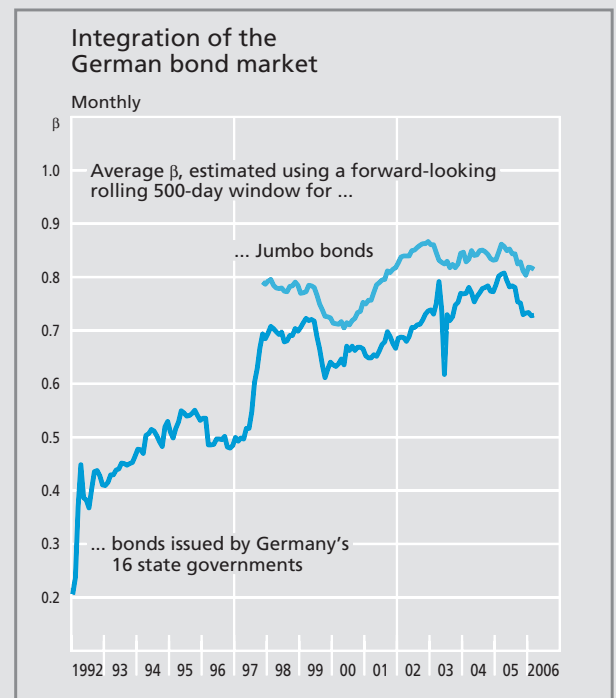
$$\Delta y_{jt} = \alpha_{jt} + \beta_{jt} \Delta y_{Bt} + \varepsilon_{jt}$$

where Δy_{jt} is the difference in the yield on a bond issued by federal state j at time t over ten trading days and Δy_{Bt} is the corresponding change in Bund yield over the same period; ε is the residual of the regression. In a fully integrated bond market, the two yields should move in line with one another, i.e. the coefficient β would be 1 and the constant α zero. The model is estimated separately for all federal states from 1992 onwards with a forward-looking window of 500 trading days, which is rolled in steps of ten

¹ Market access by buyers and sellers is another important criterion for integration. However, this can be regarded as given in the particular case of the German domestic government bond market. — ² See Baele, Ferrando, Hördahl, Krylova and Monet (2004), *Measuring European Financial Integration*, *Oxford Review of Economic Policy*, Vol

days.³ Yields are measured for bonds with a maturity of roughly ten years.

The results of the estimate show that the constant α is indeed zero. By contrast, the integration parameter β is regularly lower than 1. The chart below depicts the development of the average of the 16 β coefficients estimated at a particular point in time. Since the early 1990s, the average value of 0.4 has risen to



20, pp 509-530. By way of qualification one must note that this strict form is based on the assumption that the premiums contained in the yields of central government and federal state bonds (eg for credit or liquidity risk) do not diverge over time. — ³ For a detailed discussion on the integration of the European bond market, see Schulz and

around 0.8. This reflects increasing co-movement in the yields on central government and federal state bonds. This can probably be attributed primarily to a deepening market for federal state bonds. As a direct consequence of this market's lack of liquidity, at least in the early to mid-1990s, the possibilities for arbitrage trading to offset differences in price were limited.

If one looks at the development of Jumbo bonds issued jointly by several federal state governments rather than at individual federal state bonds, the degree of integration is systematically higher. Yields on Jumbos, which on average have a considerably larger issuance volume than simple federal state bonds, therefore display greater co-movement with Bunds than normal federal state bonds. And if one examines only particularly large federal state bonds (Jumbos and individual bonds) that are eligible for trading on electronic platforms, the degree of integration is even higher. This is another indication of how important liquidity is for the integration of the bond market.

Recently, integration measures for both Jumbos and individual bonds have dropped, reflecting widening spreads between federal state and central government bonds. This suggests that, in the recent financial

market turmoil, investors have shown a preference for the more liquid paper issued by the Federal Government (see also Factors determining interest rate premiums).

An increasing integration of the government bond markets can be observed at the European level as well.⁴ Bunds can also be regarded as a benchmark for bonds issued by the central governments of other European countries. However, in the 1990s the dispersion of the integration parameter β described above was considerably greater at the European level than it was among German federal state paper. This was due largely to exchange rate volatility prior to the introduction of the euro – even within the European Monetary System. Nevertheless, convergence of the co-movement in yields can be observed up until 1999, which can be explained by the anticipated introduction of the euro as well as generally elevated capital flows and greater comparability of bond specifications within Europe.⁵ From 1999 onwards, the parameter β for euro-area government bonds is indeed close to 1 and therefore higher than for German federal state bonds, a development which is probably the result primarily of the generally higher degree of liquidity of bond securities issued by central government.

Wolff, Sovereign bond market integration: the euro, trading platforms and globalization, Deutsche Bundesbank Research Centre, Discussion Paper, Series 1, No 12/2008. — 4 ECB (2008), Financial Integration in Europe, p 13 ff. — 5 See Pagano and von Thadden (2004), The

European Bond Markets under EMU, Oxford Review of Economic Policy, pp 531-554, and Deutsche Bundesbank, Capital flows and the exchange rate, Monthly Report, January 2002, pp 15-26.

whelming majority of federal state bonds continue to have low issue volumes and are not traded on the secondary markets. Since 1999, the individual federal states have not only raised funds exclusively in euro in the capital market but also in other currencies.

Between the 1990s and 2006, the average interest premium on federal state bonds decreased considerably compared with Bunds, but picked up again during the financial market turbulence of 2007. One major reason for the interest rate spread vis-à-vis central government bonds is the low degree of liquidity of federal state bonds. In the 1990s, in particular, they were comparatively illiquid, a fact which was reflected in higher premiums. The

particularly liquid Jumbo bonds are therefore usually traded at a lower interest rate premium than straight federal state bonds. The debt level of individual federal states, in turn, has only a slight effect on respective yields because investors clearly expect the default risk to be very low. Overall, the co-movement in federal state bonds and central government securities has increased over time. The most recent rise in the interest rate differential was due to the general increase in market players' risk aversion during the financial market turbulence. Similar trends were observed for the bonds of other euro-area countries and in risk pricing in financial markets in general.