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Moral Hazard and Bail-Out in Fiscal Federations: Evidence for the German Länder

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I. INTRODUCTION

The effect of expected bail-outs on financial market agents' risk perception is an important topic of research with empirical evidence lagging behind theoretical insights. An investor believing in a bail-out is encouraged to underprice risks leading to investor moral hazard. In particular, after the international financial crises of the mid- and late 1990s, moral hazard in the context of lending to sovereign borrowers has become a major research topic. Corsetti et al (1999) provide an interpretation of the Asian crisis as a result of moral hazard-induced over-investment, excessive external borrowing, and large current account deficits. Lane and Phillips (2000), e.g., show in an event study that IMF lending might contribute to some degree of moral hazard. Dell'Ariccia et al (2006) provide empirical evidence for declining investor moral hazard after the surprising non-bail-out in the Russian crisis of 1998. We contribute to this literature by identifying moral hazard in the German federation. Our identification strategy is based on a variable, which was used by the German Federal Constitutional Court as an indicator to determine eligibility of two German states (Länder) to a bail-out.

In this historically important bail-out procedure, two German Länder of the German fiscal federation, Bremen and Saarland, turned to the Federal Constitutional Court to force the federal government to provide bail-out transfers (see Seitz (1999) for a detailed description). These were granted 4 years later in a ruling in 1992. The court decided that both states were in a situation of

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"extreme budgetary distress" justifying a substantial bail-out on the basis of the loyalty principle ("Bundestreue") of the German federation. The size of the bail-out was substantial. To our knowledge, no study so far has investigated the consequences of this important ruling on risk perception in the German sub-national bond market. While Seitz (2000) provides details of the German federal system, Rodden (2005) finds moral hazard on the borrower side in the German federation. Lemmen (1999) performs the only regression analysis of the German sub-national bond market we know of. Based on a short sample period (1994 - 1996), he shows that spreads increase with public debt.

We identify investor moral hazard in the German fiscal federation with the indicator used by the German constitutional court. The court argued that the interest payments-to-revenue ratio is a proxy for extreme financial distress and relied heavily on this indicator to justify the entitlement to a bail-out. Accordingly, financial markets should increase their risk premium in the German sub-national bond market when facing a worsening interest payments-to-revenue ratio, reflecting higher default risk. However, if the ratio is taken by financial market participants as an indicator of larger bail-out payments, we should expect a lower risk premium for a larger ratio. The German fiscal federation thus provides a unique opportunity to directly test for moral hazard. We are able to show that financial markets significantly react to the indicator variable by asking for lower risk premia. Risk premia decrease over-proportionally with an increasing indicator suggesting increased bail-out expectations. These results therefore provide strong evidence for investor moral hazard in the German federation. Furthermore, risk premia react significantly to the relative debt level of a state (Land).

The analysis is supplemented by a closer investigation of Berlin. The Land Berlin recently claimed, similar to Saarland and Bremen in the late 1980s, that it is in financial distress. It asked the federal constitutional court to rule in favor of federal funds alleviating its situation. The court rejected the claim in October 2006. We perform an additional regression analysis restricted to data of Berlin. If Berlin is indeed in serious trouble, financial markets should pay closer attention to its state of public finance and react strongly to fiscal fundamentals and the bail-out measure. Indeed, we find that our previous regression results are confirmed with even larger coefficients hinting to non-linear effects. An event study to detect financial market reactions to the October ruling shows that the ruling did not change bail-out expectations. Overall, the case of Berlin thus confirms that financial markets are subject to investor moral hazard.

Previous literature on moral hazard in fiscal federations shows that moral hazard depends on the likelihood of bail-outs. In the USA, the moral hazard problem in national lending is small as bail-outs are very rare. For example, Orange County tried to get California to bail it out in the 1990s and failed (Halstead et al 2004). Absent bail-out expectations might be one reason, why

the effects of fiscal variables on risk premia in the US states and municipalities are usually found to be quite strong compared to OECD sample values. However, stronger reaction coefficients might also result from the large labor and capital mobility in US states, which reduce states' tax capacities (for a survey table see Lemmen (1999)). Further important studies on this topic are, e.g., Capeci (1991, 1994), Bayoumi et al (1995). In the European Economic and Monetary Union (EMU) moral hazard is often discussed in the context of changing levels and reactions of risk premia due to the introduction of the Euro. After adjusting pre-EMU yield data for exchange rate related effects, some studies even observe an increase in the average yield spread with EMU (Gómez-Puig 2006). This higher spread level, if anything, provides evidence for *lower* bail-out expectations. Regarding the sensitivity of risk premia to fiscal policy, several studies document a structural break with the beginning of EMU (Bernoth et al (2004), Heppke-Falk and Hüfner (2004), Bernoth and Wolff (forthcoming)). Codogno et al. (2003) deny a structural break. However, the results do not allow any conclusion on bail-out expectations since the introduction of the euro was anticipated and coincided with a number of institutional changes, e.g., of budgetary institutions (Hallerberg and Wolff (online first)).

The remainder of the paper is organized as follows: The next section presents our main hypotheses, the estimation equation and the data. Section III presents and discusses our main empirical results. In section IV we discuss the recent constitutional court ruling on Berlin and provide evidence on its effects on risk premia. The last section concludes.

II. METHODOLOGY

II.1. A testable framework

To test for investor moral hazard in the German government bond market, we perform a regression of the interest rate spread between the German Länder and the central government on the bail-out indicator and control variables. Our estimation equation is derived from the following model. Suppose, an investor has the choice between a risk-free investment, on which he earns a risk-free gross return of $1+r^*$, and an investment in a bond of a German Land i, which has a default probability of θ. In case of default, the investor is able to recover a fraction $\tau=1-l$ of his investment, where l denotes the loss. In a world of risk-neutral investors, the expected return on both investments has to be equal, thus:

$$1 + r^* = \theta\tau(1 + r_i) + (1 - \theta)(1 + r_i) \tag{1}$$

r_i denotes a German Land's (i) bond interest rate; this can be rewritten as:

$$\frac{r_i - r^*}{(1 + r_i)} \approx r_i - r^* = \theta l \tag{2}$$

where the approximation holds, if interest rates are small, which is a reasonable assumption for Germany. The interest spread between a Land and a risk-free bond is thus a function of the expected probability of default and the amount lost in case of default.

Again, the probability of default $\theta = \theta(X_{it})$ is a function of a number of fundamentals X belonging to Land i at time t. These fundamentals include, among others, the public debt level of a Land. Furthermore, the loss on the investment is a function of a potential bail-out. The investor will recover a greater amount of his investment, if the bail-out (b) is larger, thus $l = \mathrm{l}(b)$ with $\mathrm{l}'(\mathrm{b}) < 0$. Thus, we expect the risk premium reflected in the interest rate spread to depend positively on the probability of default, which we approximate by fiscal fundamentals. Moreover, it depends negatively on the bail-out. Accordingly, we can linearize Equation 2 to derive an estimation equation as

$$r_i - r^* = X_{it}\beta + b_{it}\gamma + u_{it} \tag{3}$$

where β and γ denote the respective sensitivities.

To capture the bail-out b empirically, we use a variable serving as an indicator to the supreme court to determine the bail-out entitlement of a Land. Investor moral hazard can be shown if the risk premium of a Land is falling with increasing size of the indicator, which reflects stronger market beliefs in a bail-out.

We thus use an explicit bail-out indicator to study investor moral hazard. This contrasts with previous studies such as Dell'Ariccia et al (2006), who have used an identified event to derive changes in bail-out expectations. Ideally, we would have liked to estimate, whether the effect of the indicator variable is different after the ruling compared to before the ruling. Unfortunately, this is not possible due to missing bond data and the structural break of German reunification. (The German Länder relied heavily on bank lending to finance their deficits in the 1980s and early 1990s. Only during the 1990s, the use of bonds to finance deficits became widespread (Schulz and Wolff (2008).) Our identification method therefore cannot rely on changed effects due to an exogenous event. Instead, we identify the existence of investor moral hazard by the sign of the effect of interest payments on public debt-to-revenue ratio. We expect a positive sign, if the ratio is a measure of financial distress. Such an increase of risk premia with higher debt services has been found by Bernoth et al.

(2004) for EU countries. On the contrary, if higher interest payments are associated with a greater bail-out likelihood, we expect a negative sign.

We estimate Equation 4:

$$r_{it} - r_t^* = \alpha_1 fiscal_{it} + \alpha_2 indicator_{it} + \alpha_3 liquidity_{it} + \alpha_4 maturity_{it} + \alpha_5 riskav_t + \mu_i + \varepsilon_{it} \quad (4)$$

where $r_i - r^*$ represents the spread between the yield of a bond issued by a German Land i at time t (r_{it}) and the yield of the benchmark issue r_t^* of the Bund at time t. This measure includes risks associated with outright default, partial default, temporary solvency problems of a Land, and liquidity. We define all fiscal explanatory variables in differences to the federal government. The explanatory factors, which are discussed in further detail below, are the following ones: Fundamental fiscal variables potentially influencing the default probability of a Land (*fiscal*), the variable indicating the entitlement to a bail-out (*indicator*), *liquidity* to capture the influence of the liquidity risk, the variable *maturity* to measure the time to maturity, and *riskav* to capture the risk aversion of the representative investor. μ_i denotes a dummy for Land i to capture Land-specific fixed effects; ε_{it} is an error term with the usual iid-properties. The equation is estimated by OLS controlling for Land specific fixed effects with Land dummies μ_i.

II.2. The bail-out indicator

In 1992, the Federal Constitutional Court decided that Bremen and Saarland were in extreme financial distress and were therefore entitled to substantial bail-out payments amounting to 20 percent of their expenditures. The determination of financial distress was based on two budgetary indicators: the "Finanzierungsquote" (deficit relative to revenue or expenditure) and the "Zins-Steuer-Quote" (interest payments relative to (tax) revenue or expenditure).[1] Our main bail-out indicator is the interest payments on public debt-to-revenue ratio (**interest-to-revenue** ratio hereafter).[2] As the deficit-to-expenditure ratio (or deficit-to-revenue ratio) is highly positively correlated with the deficit per capita variable, the effect of a deteriorating public finance situation cannot be separated from the effect of more likely bail-out payments. The latter ratio is thus not a suitable indicator for

1. BVerfGE 86, 148-Finanzausgleich II, 322.
2. The court includes in the definition of the denominator the transfers from the Länder revenue equalization system (Länderfinanzausgleich) and general supplementary transfers from the central government (Bundesergänzungszuweisungen).

identifying bail-outs.[3] The evolution of the bail-out indicator is shown in *Table 6*. While for many states we observe an increase in the interest-to-revenue ratio, some states (SD, NW, HE, BY, *Table 3* in the appendix enlists the abbreviations) also experienced declining ratios.[4]

We expect that an increase in the interest-to-revenue ratio results in an increase of the bail-out probability, which in turn should result in lower risk premia. We do not assume a break in this relationship at a specific size of our bail-out indicator as the Federal Constitutional Court does not define a clear numerical threshold of the interest-to-revenue ratio, at which a Land is in a situation of financial distress.[5] However, we do allow for possible non-linear effects in our regression analysis since with an increasing ratio a bail-out becomes increasingly likely.

The risk-reducing effect of a potential bail-out identified by the interest-to-revenue ratio needs to be empirically distinguished from the greater probability of financial loss of highly indebted Länder. Obviously, a Land with a high debt level has to pay a large amount of interest payments. A regression omitting the interest-to-revenue ratio will falsely attribute the bail-out effect to the debt variable, thereby biasing the risk increasing effect of debt downward. This raises the issue of collinearity. A typical finding when two variables are highly correlated is that they become insignificant and only a joint test reveals significance. However, if one is interested in the marginal effect of one variable and this variable is significant, the computed coefficients can be readily interpreted. Applied empirical researchers moreover compute a coefficient of tolerance, which is given as $1 - R^2$, where the R^2 is computed from a regression of the debt variable on the interest payments variable. If this coefficient is below 0.1, collinearity can be an issue of concern.

The debt level of a Land is, however, not a perfect predictor of its interest payments. Substantial differences in debt management and different times of debt issuance result in different interest payments. This can be seen when performing a fixed effects regression of the debt level on the interest payments. The within-R^2 is less than *0.23*, which points to substantially different evolutions in time of these two variables. Moreover, the Land specific annual implicit interest rates in terms of the interest payments-to-debt ratio show a heterogenous picture. The highest and the lowest implicit interest rate during a given year differ by one percentage point. In 2005, for instance, the Land with the lowest implicit interest rate pays 4 percent on its debt, while the Land with the largest payment pays 5 percent, a 25 percent difference. Furthermore, for a

3. A regression of the deficit per capita ratio on the deficit-to-expenditure ratio reveals a strong positive correlation and an R^2 exceeding 0.86.
4. The evolution of the variable over the entire horizon is available in the working paper version.
5. BVerfGE 86, 148-Finanzausgleich II, 323: "[…] Welche einzelne Quote oder welche Kombination der Quoten ab welcher Grösse eine Haushaltsnotsituation präzise definieren, kann hier offenbleiben. […]"

number of Länder, the position of a Land relative to the other Länder with respect to its implicit interest rate changes substantially. Thus, collinearity of debt and interest rates is not an issue to worry about in the present data set.

Irrespective of its positive connection with fiscal fundamentals, the interest-to-revenue ratio contains information differing from the usual variables determining risk premia such as the debt and deficit levels. While large interest payments as a ratio to revenue as such are clearly a sign of bad fiscal health and should therefore result in larger risk premia, they should be a sign of increased bail-out expectations once one controls for the debt level of a Land. Ceteris paribus, the interest-to-revenue ratio is thus an indicator of bail-out and should result in lower risk premia at a given debt level in the presence of investor moral hazard.

II.3. Remaining data

The government bond data are taken from Capital Data Bondware and range from 1993 to 2005. The data set includes individual bonds issued by the respective Land if a comparable benchmark bond by the federal government is available. Thus, central government (Bund) benchmark bonds with the same coupon payment structure, an issuing date close to the comparable bond of the Land, and an equivalent maturity are matched to the Länder issues. The yield spread is measured as the difference in the yield to maturity at the time of issue between the Land bond under consideration and the equivalent German central government bond. Moreover, Capital Data Bondware provides information on features of government bonds of the 16 German Länder such as the maturity, the underlying currency, the volume, and the announcement date (see *Table 4* for an overview of average data for 2005). Bonds are denominated in Deutsche Mark (DM) before 1999 and subsequently in euros. We dropped joint Länder issues (Länderschatzanweisungen) amounting to 21, resulting in 127 Land specific observations after split up. As they have the same issuance conditions and are subject to joint liability, they are not suitable for detecting effects of Land characteristics.

Since fiscal data are available on a yearly basis only, we match the yearly fiscal data with all individual bond emission within the fiscal year. Fiscal data are provided by the Federal Statistical Office Germany. State and local government data - the latter including special-purpose associations data except for the year 2005 - are consolidated. The annual cash data are adjusted to ESA standards by removing loans repayed/granted and sales/acquisitions of equity. Data on GDP and inhabitants are taken from the website of the statistical offices of the Bund and of the Länder.[6] Estimations are carried out with debt

6. Statistische Ämter des Bundes und der Länder at http://www.vgrdl.de/Arbeitskreis_VGR.

and deficit expressed as per capita ratios, from which the corresponding per capita data of the Bund are subtracted. Per capita values were chosen to reflect the German fiscal federal system, in which financial resources of a Land are largely determined by the population size as revenue equalization across states is based on the number of residents.[7] *Table 5* provides descriptive statistics of debt, GDP and inhabitants of the German Länder.

In addition to the default risk premium, the spread comprises a liquidity premium, reflecting the risk of not being able to sell an asset in due time. It is well captured by trading costs compensating market makers for providing immediacy with respect to the match of the supply of and the demand for a specific security (Grossman and Miller 1988). Bid-ask spreads have proved to be appropriate proxies for liquidity risk as they properly reflect such trading costs (see in this context, e.g., Flemming (2003), Elton and Green (1998), and Gómez-Puig (2006)). We decided to employ the average bid-ask spread during the year following the emission of the bond calculated on the basis of daily data. The mean average bid-ask spread in our sample is 1.29 basis points (=0.0129%), with a maximum average bid-ask spread of 6.29 basis points for a 1995 emission of Land Saxony-Anhalt. Moreover, we included the issue size as an alternative proxy for liquidity as the latter increases with the volume. However, the coefficient turned out to be insignificant and is therefore not reported here.

One important determinant of yield spreads is the general investors' risk aversion towards credit risk. Since investors' risk aversion is not directly observable, we use, similar to Codogno et al (2003), Favero and Giavazzi (2004) and Bernoth et al (2004), the yield spread between low-grade US corporate bonds (BBB) and benchmark US government bonds (AAA) as an empirical proxy. A rise in this spread indicates an increase in the investors' risk aversion, and vice versa. With this measure we also capture the co-movement of the spreads in time.

Since our data set contains bond issues with different maturities, we control for *maturity*, which measures the time to maturity of the bonds at the time of issue. We expect that an investor demands a compensation for investing in long-term bonds as the default risk increases with time to maturity. The increase in the compensation for low-grade bonds should be larger than for highly graded bonds.

In addition, we perform further regressions to control for the size of the different Länder. To do so, we include the number of inhabitants measured in thousands. We expect larger states to pay lower risk premia for several reasons. First, larger states are of greater relevance to the financial system as a whole, a

7. At least 75 % of VAT income belonging to the Länder is distributed according to the number of residents. Moreover, for the calculation of financial equalization needs and provisions in the Länder revenue equalization system (Länderfinanzausgleich) the number of inhabitants of some Länder is raised fictitiously. This procedure is justified by additional financial requirements per resident in these regions.

non-bail-out is therefore less likely (too big to fail). Second, larger states are less likely to be subject to a big shock as their economies are more diversified.

Moreover, we control for a potential structural break due to the introduction of the Euro, which could have facilitated access to the European capital market by introducing an EMU dummy. The EMU dummy captures the period after 1998; observations in this time span (131) exceed those before 1999 (38) by far as Länder recently rely more heavily on bonds to finance deficits.

III. RESULTS

III.1. Baseline results

Table 1 presents our main estimation results. In line with our hypothesis, the bail-out indicator (the interest payments-to revenue ratio) is a highly significant negative determinant of risk premia (Regression B). Thus, given a certain debt

Table 1

Determinants of Risk Premia of German Länder

	A	B	C	D	E
debt per capita	**2.09**	**4.62**	**6.42**	**4.59**	**4.08**
	1.88	3.15	3.94	2.42	2.19
deficit per capita	**2.91**	**4.41**	**4.52**	**5.08**	**5.30**
	0.89	1.35	1.41	1.59	1.69
bid-ask	**3.57**	**3.48**	**3.53**	**3.41**	**3.01**
	2.88	2.87	2.96	2.87	2.57
maturity	**1.80**	**1.93**	**1.79**	**1.75**	**1.49**
	6.95	7.44	6.83	6.70	5.48
corspread	**0.17**	**0.15**	**0.14**	**0.13**	**0.15**
	6.16	5.31	4.81	4.43	5.12
EMU	**2.58**	**13.57**	**13.07**	**14.97**	**8.54**
	0.69	2.42	2.36	2.68	1.44
interest payments/revenue		**− 250.18**	**− 671.83**	**− 597.85**	**− 813.17**
		− 2.59	− 3.35	− 2.95	− 3.82
(interest payments/revenue)^2			**− 2392.07**	**− 2049.70**	**− 3632.00**
			− 2.39	− 2.03	− 3.18
inhabitants				**− 0.02**	**− 0.05**
				− 1.85	− 3.22
debt per capita^2					**0.0006**
					2.76
cons	− 10.42	− 30.13	− 35.21	382.43	891.95
	− 0.8	− 2.03	− 2.39	1.65	3.06
N	169	169	169	169	169
R^2	0.54	0.56	0.57	0.58	0.60

Notes: Dependent variable: yield spread measured as spread between yield to maturity at issue of a country bond and a comparable benchmark bond of the Bund in basis points. Maturity in years. All regressions include Länder dummies not shown here. t-values below bold coefficients.

level, financial markets will demand less risk premium from a country with a higher interest payments-to-revenue ratio. If a large interest burden is indeed a sign of financial distress as the supreme court implied by its ruling, a higher interest payments-to-revenue ratio should increase default risk premia instead of lowering them.

However, according to our results, financial markets seem to believe that a larger interest payments-to-revenue ratio reduces default risk. This counter-intuitive effect can be explained by the ruling of the constitutional court enabling a bail-out. By openly using this ratio as a criterion to determine financial distress and thereby to grant to a Land the right to receive federal aid, the supreme court explicitly indicates to financial markets that Länder with large interest-to-revenue ratios are in fact less risky. Moreover, financial markets might reward very large interest-to-revenue ratios over-proportionally as a bail-out is even more likely. This suggests that the coefficient on the squared interest-to-revenue ratio should be negative, a predicition confirmed in regression C. Both regressions B and C thus lend strong support to the moral hazard hypothesis.

Furthermore, we also find our predictions on the debt per capita variable confirmed. Larger values are significantly increasing risk premia. Moreover, the regression coefficient more than doubles after appropriately controlling for the bail-out indicator. Apparently, in regression A the debt coefficient is downward biased by the omitted bail-out indicator. Thus, in regression A the coefficient gives a mixed result of the debt variable, which increases risk premia, and the correlated interest payments, which lower risk premia through moral hazard.

We also test for possible non-linear effects of public debt per capita. We expect that risk premia should increase over proportionally with debt, so that the coefficient on the squared term should be positive. Our empirical results in regression E confirm this. The positive coefficient on the squared debt term indicates that risk premia increase over-proportionally with public debt. In their sample of US states, Bayoumi et al (1995) interpret this over-proportional increase as an indication of functioning market discipline since access to new credit will become increasingly difficult. However, as regards our results, the estimated coefficient is – while significant – relatively small suggesting that disciplining effects are weak.

Quantitatively, the effects of changing debt and interest payment levels are as follows. An increase of the debt per capita level by 1000 Euros will increase the risk premium by 4.6 basis points (regression B). At the same time an increase of the interest payments-to-revenue ratio by one percentage point has a risk premium reducing effect of 2.5 basis points. Thus, a Land worsening its interest payments to revenue ratio by 25 percent from the mean of 8 percent to 10 percent will improve its risk premium by 5 basis points. This increase

corresponds to a move from the lowest (4 percent) to the highest (5 percent) implicit interest rate as documented in the previous section 2.2. The increase of the risk-premium due to a higher debt level will be partly offset by the risk reducing effect of larger interest payments. Suppose the average state would increase its per capita debt by 1000 Euros and would have to pay the average implicit interest rate. This would lead to an increase of the interest-to-revenue ratio by 1.2 percentage points, which would lower the risk premium by roughly 3 basis points. The overall increase in the risk premium would amount to $1.6=4.6-3$ basis points, i.e., less than 0.02%. Our estimation results thus document significant financial market reactions of risk premia, which are, however, relatively small compared to the actual interest rates.

Hence, even though markets believe in an eventual bail-out in case of a debt crisis, risk premia overall raise with rising debt levels. In our view, this can be explained by two factors. First and most importantly, financial markets care about timely re-payment of debt. Increased debt levels lower the ability of governments to roll over maturing debt in case of financial difficulties. Any expected delay in the servicing of debt is associated with increased risk premia. This interpretation of risk premia as reflecting timely re-payment is supported by the way rating agencies differ in their assessment, depending on whether they focus on timely repayment or eventual default. Unlike Fitch, Standard & Poor's differentiates between the credit quality of the Länder primarily out of concern over the speed with which bail-outs would be administered in the event of a debt servicing crisis.[8] Second, there is a small remaining risk, that the federation will not grant unlimited support if the state deliberately tried to get into financial difficulties thereby forcing the federation to pay. This remaining uncertainty regarding the decision of the federal constitutional court also contributes to risk premia and risk differences as a function of debt.

The deficit per capita variable is an insignificant determinant of risk premia in all regressions. Thus, a worsening fiscal position apparently does not increase risk premia. The weak effect of deficits might be caused by two opposing driving forces. On the one hand, a large deficit implies a worsening of the fiscal position of a Land. On the other hand, the supreme court relied on the deficit to revenue ratio as an indicator for financial distress, making a bail-out more likely. This in turn would imply lower risk premia. These two effects might cancel each other out resulting in insignificant deficit coefficients. As pointed out above, we cannot separate these two effects empirically.

8. The rating agency "Standard and Poor's" assigns different ratings to the Länder as one of the focuses of their ratings is on the timeliness of the debt servicing. An important variable in their assessment is therefore the amount of debt refinancing required. The rating agency Fitch, in contrast, looks at eventual default and therefore classifies all Länder as having the same risk as the federal government, implicitly assuming that ultimately a bail-out is guaranteed.

Regarding the control variables, we find previous results confirmed. Our proxy for liquidity, the bid-ask spread, drives the yield spread between Länder and the Bund significantly up, reflecting the importance of the liquidity premium. Moreover, spreads significantly increase with the time to maturity of the bond. Furthermore, risk premia increase when our proxy for risk aversion (*riskav*) increases. The population size of a Land (inhabitants) also has the expected sign and is a significant negative determinant of default risk. The included Länder dummies are also found to be significant.

III.2. Robustness checks

In addition to our main estimations, we carried out several robustness checks. An obvious criticism of our findings is that Länder with large debt levels shoulder great interest payment burdens. Our estimation results might therefore be artificially generated by including a variable positively correlated with debt in the regression. To lend further support to our hypothesis, we estimate the same regression, but replace the interest payments-to-revenue ratio by the interest payments-to-GDP ratio (Regression A in *Table 7*). If the negative coefficient resulted from the positive correlation between debt and interest payments, this regression should equally exhibit a positive coefficient for the debt and a negative for the interest-to-GDP ratio. As regression A shows, the interest payments-to-GDP ratio is not a significant determinant of risk premia. This confirms our view that the negative coefficient of the interest payments-to-revenue ratio is driven by the fact that markets consider this varaible as an indicator and believe in bail-out. We are therefore confident that the estimation results reflect the risk assessment of financial market participants and provide strong evidence for investor moral hazard.

In a first check on sub-sample stability of our results (I), the five new East-German Länder are dropped from our panel as they started with low debt levels after the German re-unification and received considerable transfers from the central government and EU cohesion funds. Old and new Bundesländer might therefore face a different risk perception by financial market agents. The results (*Table 7*, regressions B-F) are, however, very similar to those of the main estimations, indicating sub-sample stability.

In a further check (II, *Table 8*), we drop the city states as they have a special position in the German fiscal federal system. Moreover, compared to non-city states, they are high debt-per-capita Länder exceeding 10 thousand Euros by far. As debt in our regressions is normalized by the real population size, it is larger than it would be in the Länder equalization scheme, which assumes larger populations due to larger financing needs of city states (see Footnote 5). Thus, debt relative to true financial resources for the city-states is de facto

smaller than the debt per capita variable used in the baseline regressions. We therefore expect the debt coefficient size to be larger if the city states are excluded. Indeed, after having dropped Berlin, Bremen, and Hamburg, debt per capita drives risk premia significantly up with a larger estimated coefficient. The coefficient on the indicator variable is again similar to our benchmark regressions.

In a third robustness check, we constrain the data set to maturities between 5 and 10 years. We excluded observations with a maturity of less than 5 years as we are in particular interested in the long-run default risk. Moreover, for maturities above 10 years many maturities up to 30 years are not covered by an emission. The results differ only slightly from the baseline regression (see *Table 9*).

Finally, we perform instrumental variable regressions to address potential endogeneity concerns (*Table 10*). In fact, interest payments might be endogenous to the spread at launch, as the risk premium is a part of the interest payments. However, the effect is probably quite small, since only a small fraction of debt is rolled over in a given year. Nevertheless, we want to be sure that our results are not driven by this effect. We therefore instrument the interest payments-to-revenue ratio and the interest payments-to-GDP ratio by their first lag. These lagged values should be good instruments as they are not determined by future risk premia but highly correlated with future interest payments (as confirmed by the first stage regressions). The IV regressions fully confirm our previous analysis. We even find somewhat stronger effects of moral hazard. Altogether, the robustness checks thus confirm the baseline regressions with regard to our main variables.

IV. THE CASE OF BERLIN

This section provides a more detailed analysis of risk premia in Berlin for two reasons. First, Berlin is suffering from a very unfavorable budgetary performance (see *Table 5*). It has the second highest interest payments-to-revenue ratio in 2005 and the highest growth rate of per capita debt among the 16 Länder between 2000 and 2005. The 2005 average yield spread between Berlin-bonds and corresponding high-quality-benchmark bonds issued by the federal government is the third largest (see *Table 4*), which may go back to a relatively high default risk perception. Second, Berlin's financial difficulties in 2003 culminated in a claim to financial aid, resulting in a ruling on 19 October 2006. In 2003, Berlin's senate applied for a decision on the existence of extreme financial distress at the supreme court, which would have been the basis for financial aid. Accordingly, we first present a regression analysis restricted to the observations of Berlin to detect, whether financial markets are particularly vigilant with a Land in difficulties, which in the above analysis we tried to

Table 2

Determinants of Risk Premia for Berlin

	A	B
debt per capita	− **1.57**	**20.27**
	− 0.68	3.44
deficit per capita	− **27.55**	− **39.45**
	− 1.66	− 3.11
bid-ask	**0.53**	**0.95**
	0.23	0.56
maturity	**1.51**	**1.04**
	1.96	1.78
corspread	**0.36**	**0.65**
	2.99	5.59
interest payments/revenue		− **1867.75**
		− 3.87
cons	− **39.67**	− **214.85**
	− 1.99	− 4.51
N	23	23
R^2	0.67	0.83

Notes: Dependent variable: yield spread measured as spread between yield to maturity at issue of a Berlin bond and a comparable benchmark bond of the Bund in basis points. Maturity in years.

capture with non-linear effects. In a second step, we look at the impact of the court procedures on financial market's risk assessment.

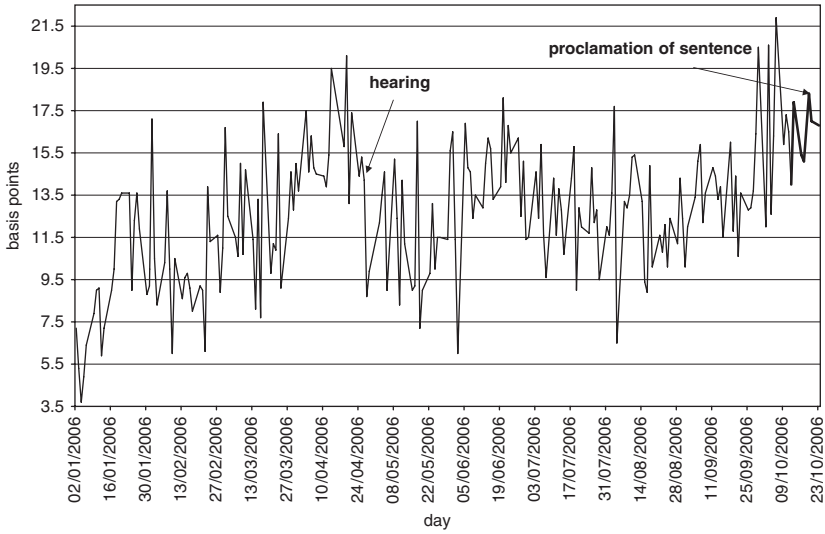
Since the state of Berlin itself was filing for financial aid, an additional regression analysis restricted to observations of Berlin might provide further insights into investor moral hazard. In *Table 2*, we present the regression results of estimations carried out as before. As can be seen, the main regression results remain valid. The interest-to-revenue ratio exercises a highly significant and negative effect on the risk premium. Its coefficient size is larger than in the previous regression analysis, suggesting that in the case of Berlin financial markets paid particular attention to the fiscal distress indicator of the supreme court. The large coefficient size is also in line with the non-linear effects identified above and indicates that Berlin is on the "steeper" parts of the risk premia reaction function.

Somewhat surprising, the deficit per capita variable is now significant and negative, while it was insignificant before. In the panel regression, we argued that the two effects related to the deficit - the deterioration of the Land's public finances and the increased likelihood of a bail-out - might cancel each other out and could not be empirically distinguished. For Berlin, the increased likelihood of a bail-out effect appears to dominate in the data. This lends further support to our hypothesis that financial markets carefully watch the indicators of bail-out probability and accordingly reduce their risk assessment.

The Federal Constitutional Court in its decision of 19 October 2006 denied the existence of an extreme financial distress, which would have been the basis

Figure 1

Yield Spread between a Berlin and a Central Government Bond in 2006



for Berlin's claim. The spread of Berlin's bonds could have increased or decreased. On the one hand, the Federal Constitutional Court made clear that Berlin is currently not in a situation of fiscal distress. It furthermore did not exclude the possibility of a bail-out. This might have contributed to a lowering of the risk premium. On the other hand, financial markets might have expected a decision supporting Berlin's claim for additional funds. In this case, the decision represents a negative surprise potentially raising the risk premium on Berlin's debt.

We descriptively investigate whether the time of the hearing, which took place on 26 April 2006, or the decision of the court itself on 19 October 2006 represents relevant news to financial markets changing their risk assessment. *Figure 1* illustrates the development of the spread between the yield of a representative Berlin-bond[9] and the current yield of central government bonds with an equivalent residual term. Over the year 2006, the spread shows a slight upward trend: The average monthly spread raised from 15 basis points (bps) in April 2006 to 16.5 bps in October 2006. On the first day after the hearing, the yield spread fell from above 14 to almost 9 bps, potentially showing a lowering of Berlin's risk. In October, the spread varied largely. The impact of the proclamation of sentence on 19 October was negligible: The spread fell from 18

9. The Berlin-bond has the ISIN DE000A0BNQX7. It was issued in September 2004 with a maturity of 10 years and amounted to 2 billion Euros.

bps to almost 17 bps on 23 October. In summary, court proceedings affected the risk premium on Berlin's bond yields only marginally at best, and that negatively, given that no new information on the fiscal fundamentals were released on these days. Thus, the court's proceedings did not alter bail-out expectations. This outcome confirms the estimation results for the period before 2006.

V. CONCLUSIONS

We tested for investor moral hazard in government bonds issued by the 16 German Länder between 1993 and 2005. For this purpose, debt and fiscal balance per capita and an indicator - the interest payments-to-revenue ratio - used by the Federal Constitutional Court to decide whether a Land is in a situation of financial distress entered our estimation equation. We revealed debt per capita and the interest payments-to-revenue ratio as statistically significant determinants of the default risk premium. While debt per capita affects the premium positively, the interest payments-to-revenue ratio has a counter-intuitive negative sign. What could be the reason for this outcome? We suggest that financial market agents link a higher ratio with a de facto *smaller* default risk as a bail-out in terms of additional financial aid by the central government, the Bund, becomes more likely. This hypothesis is further supported by a non-linear reaction of spreads: with an increasing indicator risk premia are reduced over-proportionally. This is evidence for investor moral hazard.

Furthermore, we reveal the importance of liquidity risk: Liquidity, here measured as bid-ask spread, drives the interest rate spread between the German Länder and the Bund up. Moreover, the corporate bond spread, which captures the risk attitude of the representative investor, and the maturity affect the interest rate spread also positively. All results hold after robustness checks with respect to sample changes addressing the special features of the five new member states as well as of the city-states, different maturities, and endogeneity problems.

A further detailed study of Berlin was performed as it faces a poor budgetary performance compared to the other Länder and recently filed for federal funds, a claim rejected by the constitutional court. The effects of the bail-out indicator and fiscal variables are stronger: The coefficients of debt per capita and of the interest payments-to-revenue ratio are much larger in absolute terms than in the whole sample. Furthermore, and in contrast to the panel regressions, deficit per capita becomes statistically significant, and that with a negative sign. Obviously, in the case of Berlin, bail-out expectations overcompensate the opposite effect of deteriorating public finances. This supports the investor moral hazard hypothesis. Furthermore, we show that the court procedures did not alter bail-out expectations. In sum, Berlin's data thus confirm investor moral hazard in Germany.

APPENDIX

Table 3

Länder Codes

	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

Table 4

Financial Market Statistics of German Länder in 2005

	yield spread	volume	maturity	number of issues
BB	6.3	500	10	1
BE	11.1	462.5	5.7	10
BW	7.4	633.3	7.1	3
BY	1.3	1000	8	1
HB	./.	./.	./.	./.
HE	13.5	437.5	8.7	4
HH	./.	./.	./.	./.
MV	./.	./.	./.	./.
NI	5.8	1500	10	1
NW	10.9	364.6	5.6	12
RP	5.9	500	2	1
SD	./.	./.	./.	./.
SH	./.	./.	./.	./.
SN	./.	./.	./.	./.
ST	14.7	1000	10	1
TH	4	500	9.7	1

Notes: Volume in million Euros. Yield spread: Spread between yield to maturity at issue of a country bond and the benchmark bond of the Bund in basis points. Maturity in years. Sources: Capital bond data software, own calculations. ./. denotes no issue.

Table 5

Descriptive Statistics of German Länder

	Inhabitants	GDP per capita		Debt per capita		Debt to GDP
	2005	1991	2005	1991	2005	2005
BB	2562100	7660	18755	434	7674	40.92
BE	3391400	18428	23470	2354	16919	72.09
BW	10731200	23430	30818	2829	4360	14.15
BY	12457000	22724	32408	2126	3179	9.81
HB	662700	26838	36929	11459	18806	50.93
HE	6092900	24419	32454	4097	6803	20.96
HH	1738500	33844	45991	5916	12239	26.61
MV	1713200	7470	18263	353	7572	41.46
NI	8005900	18890	23534	4040	7545	32.06
NW	18059800	21184	27080	4327	8231	30.4
RP	4059600	19301	24007	3956	7949	33.11
SD	1052500	19230	26090	7281	9597	36.78
SH	2829000	19304	24381	4574	8474	34.76
SN	4283600	7597	20032	388	4107	20.5
ST	2483500	7139	19376	385	9389	48.46
TH	2345100	6625	19047	440	7958	41.78

Notes: Per capita volumes in Euros. Debt per GDP and interest payments-to-expenditure ratio in per cent. Sources: Statistisches Bundesamt (Federal Statistical Office Germany), own calculations.

Table 6

Ratios of the Variables Used by the Supreme Court in its 1992 Ruling to Determine "Fiscal Distress"

	Interest payments-to-revenue ratio		Fiscal balance-to-expenditure ratio	
	1991*	2005	1991*	2005
BB	1.1	7.6	− 18.8	− 2.9
BE	2.9	13.2	− 3.8	− 8.1
BW	5.3	5.5	− 3.9	− 5.5
BY	4.3	3.5	− 1	− 0.7
HB	15.2	16.7	− 13.1	− 26.8
HE	7.1	6.9	− 4.5	− 4.7
HH	8.2	10.5	0.2	− 2.9
MV	0.9	7.2	− 10.2	− 4.5
NI	8	10.1	− 3.5	− 10.2
NW	9.1	8.3	− 4.4	− 7.6
RP	8.7	9.9	− 3.7	− 10.9
SD	16.2	12.8	− 10.4	− 18.3
SH	8.7	10.1	− 5.8	− 14.3
SN	0.6	4.3	− 13.9	1.9
ST	0.9	9.4	− 18.1	− 8.1
TH	1.1	8.6	− 15.6	− 6.7

Notes: In percent. *1992 for BB, MV, SN, ST, TH.
Sources: Federal Statistical Office Germany, own calculations.

Table 7

Determinants of Risk Premia of German Länder, Robustness Check I

	A	B	C	D	E	F
debt per capita	**3.80**	**2.13**	**4.88**	**5.59**	**4.52**	**3.36**
	2.35	2.05	3.42	3.36	2.14	1.55
deficit per capita	**2.77**	**3.97**	**7.30**	**7.45**	**6.98**	**6.34**
	0.85	1.05	1.89	1.92	1.78	1.63
bid-ask	**3.28**	**1.20**	**1.07**	**1.10**	**0.94**	**0.40**
	2.63	0.86	0.79	0.81	0.68	0.29
maturity	**1.84**	**1.57**	**1.66**	**1.63**	**1.61**	**1.36**
	7.10	5.55	6.01	5.84	5.74	4.45
corspread	**0.15**	**0.14**	**0.11**	**0.11**	**0.11**	**0.13**
	5.14	4.95	3.71	3.55	3.46	3.97
EMU	**7.87**	**− 4.40**	**7.61**	**7.93**	**9.27**	**5.32**
	1.51	− 1.06	1.27	1.32	1.49	0.83
interest payments/revenue			**− 295.53**	**− 441.02**	**− 399.92**	**− 558.46**
			− 2.72	− 2.15	− 1.89	− 2.50
(interest payments/revenue)^2				**− 823.12**	**− 792.56**	**− 2236.74**
				− 0.83	− 0.80	− 1.85
inhabitants					**− 0.01**	**− 0.05**
					− 0.82	− 2.02
debt per capita^2						**0.0005**
						2.02
interest payments/GDP	**− 1045.91**					
	− 1.45					
cons	− 14.12	− 25.77	− 39.47	− 42.24	237.35	868.17
	− 1.07	− 2.45	− 3.46	− 3.56	0.74	1.95
N	169	129	129	129	129	129
R^2	0.54	0.59	0.61	0.61	0.62	0.63

Notes: Dependent variable: yield spread measured as spread between yield to maturity at issue of a country bond and a comparable benchmark bond of the Bund in basis points. Maturity in years. Regression A with full sample, using interest-to-GDP ratio. Robustness check B-F by excluding the five new member states.

Table 8

Determinants of Risk Premia of German Länder, Robustness Check II (Without City States)

	A	B	C	D	E
debt per capita	**2.44**	**6.81**	**8.31**	**2.40**	**8.53**
	1.43	2.97	3.78	0.78	1.56
deficit per capita	**3.11**	**3.77**	**0.59**	**1.06**	**1.97**
	0.84	1.04	0.17	0.31	0.56
bid-ask	**3.96**	**3.74**	**3.27**	**2.82**	**2.87**
	2.77	2.68	2.47	2.17	2.22
maturity	**1.77**	**1.95**	**1.71**	**1.54**	**1.42**
	6.24	6.87	6.21	5.61	4.92
corspread	**0.17**	**0.14**	**0.11**	**0.12**	**0.12**
	5.40	3.96	3.42	3.64	3.63
EMU	**2.85**	**19.04**	**17.37**	**14.12**	**14.86**
	0.66	2.65	2.55	2.09	2.20
interest payments/revenue		**− 323.19**	**− 1438.13**	**− 1464.69**	**− 1480.67**
		− 2.78	− 4.72	− 4.93	− 4.99
(interest payments/revenue)^2			**− 6121.27**	**− 6817.84**	**− 6618.53**
			− 3.93	− 4.42	− 4.28
inhabitants				**− 0.04**	**− 0.05**
				− 2.68	− 2.94
debt per capita^2					**0.0007**
					1.35
cons	− 53.31	− 76.63	− 98.50	695.94	810.74
	− 3.44	− 4.44	− 5.7	2.42	2.72
N	142	142	142	142	142
R^2	0.53	0.55	0.60	0.63	0.63

Notes: Dependent variable: yield spread measured as spread between yield to maturity at issue of a country bond and a comparable benchmark bond of the Bund in basis points. Maturity in years. Robustness check by excluding the three city states.

Table 9

Determinants of Risk Premia of German Länder, Robustness Check III (5–10 Year Maturity Only)

	A	B	C	D	E
debt per capita	− **0.11**	**4.33**	**5.27**	− **0.74**	− **0.71**
	− 0.08	2.62	3.28	− 0.41	− 0.39
deficit per capita	**4.76**	**5.03**	**1.16**	**0.35**	**0.24**
	1.45	1.69	0.37	0.13	0.09
bid-ask	**4.40**	**3.60**	**2.93**	**1.99**	**1.88**
	3.04	2.73	2.29	1.76	1.64
maturity	**0.80**	**0.67**	**0.59**	− **0.04**	− **0.04**
	1.44	1.32	1.22	− 0.09	− 0.09
corspread	**0.16**	**0.13**	**0.11**	**0.10**	**0.10**
	5.70	4.63	4.40	4.22	4.00
EMU	− **1.84**	**17.53**	**15.15**	**15.76**	**13.88**
	− 0.39	2.86	2.56	3.07	2.31
interest payments/revenue		− **411.25**	− **1139.29**	− **1189.84**	− **1218.16**
		− 4.36	− 4.35	− 5.23	− 5.23
(interest payments/revenue)^2			− **3974.70**	− **4556.62**	− **4807.09**
			− 2.96	− 3.90	− 3.86
inhabitants				− **0.06**	− **0.06**
				− 5.22	− 4.36
debt per capita^2					**0.0001**
					0.61
cons	− 68.29	− 100.78	− 116.07	960.87	1061.79
	− 4.39	− 6.32	− 7.22	4.9	4.12
N	102	102	102	102	102
R^2	0.67	0.73	0.76	0.82	0.82

Notes: Dependent variable: yield spread measured as spread between yield to maturity at issue of a country bond and a comparable benchmark bond of the Bund in basis points. Maturity in years. Robustness check by restricting analysis to bonds issued with maturity between 5 and 10 years.

Table 10

Determinants of Risk Premia of German Länder, Robustness Check IV (Instrumental Variable Regressions)

	A	B	C	D
debt per capita	**1.77**	**14.08**	**8.38**	**5.89**
	1.14	3.1	2.05	1.51
deficit per capita	− **0.91**	− **2.25**	− **1.64**	− **1.44**
	− 0.29	− 0.62	− 0.51	− 0.46
bid-ask	**3.15**	**2.41**	**2.12**	**1.79**
	2.84	1.84	1.83	1.58
maturity	**1.36**	**0.83**	**0.71**	**0.42**
	4.70	2.24	2.12	1.22
corspread	**0.15**	**0.08**	**0.08**	**0.12**
	5.55	1.98	2.22	3.44
EMU	**19.96**	**24.48**	**26.07**	**13.17**
	2.86	2.88	3.47	1.70
interest payments/revenue	− **389.94**	− **2927.57**	− **2295.12**	− **2244.53**
	− 2.91	− 3.42	− 3.09	− 3.13
(interest payments/revenue)^2		− **13038.99**	− **9894.96**	− **10805.58**
		− 3.17	− 2.80	− 3.09
inhabitants			− **0.04**	− **0.08**
			− 3.22	− 4.72
debt per capita^2				**0.0008**
				3.29
cons	− 125.59	− 138.26	− 83.69	− 55.13
	− 6.21	− 5.66	− 2.21	− 1.52
N	158	158	158	158
R^2	0.56	0.42	0.55	0.58

Notes: Dependent variable: yield spread measured as spread between yield to maturity at issue of a country bond and a comparable benchmark bond of the Bund in basis points. Maturity in years. Instrumental variable (two-stage least square) regressions. Instruments of interest payments/revenue and squared ratio are their first lags respectively.

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SUMMARY

We identify investor moral hazard in the German fiscal federation. Our identification strategy is based on a variable, which was used by the German Federal Constitutional Court as an indicator to determine

eligibility of two German states (Länder) to a bail-out, the interest payments-to-revenue ratio. While risk premia measured in the German sub-national bond market react significantly to the relative debt level of a state (Land), we also find that a larger interest payments-to-revenue ratio counter-intuitively lowers risk premia significantly. Furthermore, with increasing values the risk premia decrease more strongly. This is evidence of investor moral hazard, because a larger indicator value increases the likelihood of receiving a bail-out payment. Our findings are robust to a variety of sample changes. In addition, we provide a case study of the recent Federal Constitutional Court ruling on the Land Berlin, which had filed for additional federal funds. The negative response of the court did not lead to a change in financial markets' bail-out expectations. In sum, our results indicate significant investor moral hazard in the sub-national German bond market.