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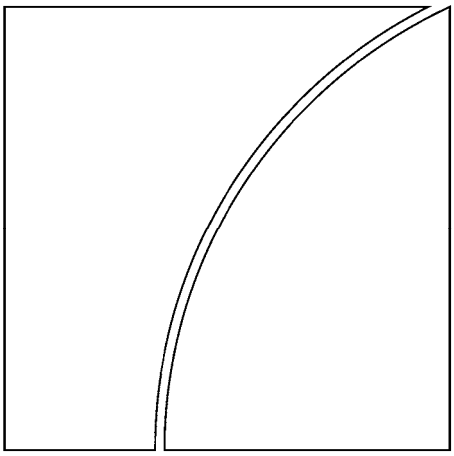

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by Michael Brei and Blaise Gadanecz

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JEL classification: G15, G21, G32, E51

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Public recapitalisations and bank risk: evidence from loan spreads and leverage

Michael Brei[1] and Blaise Gadanecz[2]

A number of countries' authorities put in place bank rescue packages using public funds in response to the global financial crisis. Were these public recapitalisations followed by a reduction of risk in banks' loan books? To answer this question, in this paper the balance sheets and syndicated loan portfolios of 87 large internationally active banks, approximately half of which were rescued during the crisis, are analysed for the period 2000–10. Evidence is presented that banks that were later rescued took on higher risk in their loan books before the crisis than banks that were not, especially in their home markets. Although the riskiness of loan signings started diminishing across the board in 2009, we do not find consistent evidence that rescued banks reduced their risk relatively more than non rescued banks during the crisis.

Keywords: external support, portfolio choices, home bias, risk, banks, syndicated loans

JEL classification: G15, G21, G32, E51

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Introduction

The recent economic and financial crisis has raised concerns in terms of its impact on banks' ability to perform financial intermediation. As the bankruptcy of Lehman Brothers dramatically shook financial markets and investor confidence in September 2008, a number of authorities announced bank rescue packages, in order to ensure the solvency of systemically important financial institutions and restore confidence in the financial system (see Borio et al (2010) for an overview). There is no consensus in the literature on the appropriateness of public bank rescues. One aspect is that such interventions, targeted and non-targeted, distort banks' incentives because they signal authorities' willingness to accommodate banks' excessive risk, which eventually reduces the future credibility of regulators. This is exacerbated if the expectation of state support leads banks to incur higher risk. Another aspect is that the rescues, necessitated by the severity of the financial crisis, have prevented a collapse of financial intermediation and better aligned banks' incentives in terms of their risk/return choices. It is argued that public interventions are likely to have been associated with increased regulatory monitoring (especially in the case of individually targeted bank rescues).

While the appropriateness and effects of public rescue packages are still being debated[3], in this paper we examine one question in particular. Did the public rescue operations contribute to a reduction of risk in banks' loan books in the years when they were granted and the years that followed? Have they helped in making institutions with risky lending activities safer? The subject of our analysis is one of the most traditional types of financial intermediation activity, bank lending. In particular, we focus on the market for syndicated loans, a relatively significant component of banks' total portfolio of commercial and industrial loans.[4] Importantly, the available information on individual loan transactions makes the syndicated loan market a good laboratory for analysing bank risk with micro data. Indeed, in addition to loan commitment amounts, information is available on the terms of lending such as individual borrower characteristics (rating, sector of activity, and country of origin) and loan features (spreads, leverage, maturities, covenants, and currency). These measures have in several instances given indications of bank risk not contained in market-based proxies like credit default swap (CDS) spreads, rating agency scores such as expected default frequencies (EDFs), or balance sheet indicators such as bad loans (see discussion in Section 2).

Our first main finding is that rescued banks' syndicated lending exposures have been riskier before the crisis than those of non rescued institutions. This is apparent in their involvement in the leveraged loan segment, in the spreads that they charge on the facilities that they originate, and in the ratings migrations of their borrowers. The greater risk is especially apparent in respect of rescued banks' syndicated lending on their home markets.

Our second main finding is that rescued banks reduced their risk relatively more during the crisis than non rescued banks. This is despite the fact that risk in the loan books started diminishing across the board in 2009, implying that rescued banks continued to write riskier syndicated loans than their non rescued peers.

The rest of the paper is structured as follows. The next section reviews the related literature and lays down the main questions. The second section gives an overview of the data used for the empirical analysis and compares rescued and non rescued banks in terms of their activities and riskiness. Section 3 substantiates the findings by means of a regression

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[3] See, for instance, Diamond and Rajan (2011) or Black and Hazelwood (2012).

[4] As of end 2010, the syndicated loan exposure of banks in our sample represented up to 16% of their total loans outstanding. The market is representative in the sense that with $7 trillion of new facilities signed in 2007, it is one of the largest sources of corporate funding. For an analysis of its collapse during the crisis, see Chui et al (2010).

analysis. Robustness checks are discussed in Section 4. The final section concludes and offers some suggestions for further work.

1. The main questions and related literature

Between early 2007 and early 2009, the banking sectors of a number of major industrial countries lost up to 80% of their stockmarket values. Authorities responded by conducting rescue operations, which took the form of deposit insurance, guarantees of newly issued bank debt, capital injections, asset insurance, and asset purchases.[5] While deposit insurance and debt guarantees were generalised in nature (ie available to all banks in a given jurisdiction), other rescue operations were mostly targeted at individual institutions. Public recapitalisations in the G10 countries totalled close to $500bn between 2007 and 2010 (Brei et al (2011)). Against this backdrop, Figure 1 shows the time profile of public recapitalisations and their repayments per country, along with the number of banks under support. Most of the funds were injected in 2008Q4 and 2009Q1, mainly in the US (with the TARP programme), the UK, Germany, Netherlands, and France. About 50% of capital injections had been repaid by end-2009 (mainly in the US and France).

The expectation of financial support in the event of stress can adversely influence banks' individual and collective incentives. Support may be explicitly or implicitly granted because of the institution's systemic importance (or its adverse impact on the functioning of the system as a whole in case of failure), a concept which has been the subject of intense policy debate recently.[6] Merton (1977, 1978) was among the first to formalise the idea of adverse incentives entailed by implicit or explicit guarantees. He describes fixed-rate deposit insurance as a put option that provides wealth-maximizing banks with an incentive to increase risk with a view to obtaining a larger insurance subsidy. Banks are not penalised for taking on greater risk since they can issue deposits near the risk-free rate to finance risky projects. In addition, they are allowed to keep the potential upside gain while transferring part of the downside risk to the deposit insurer. Higher risk taking by banks which have an expectation of support in case of difficulties can manifest itself through weaker risk management and control and through smaller capital buffers (Demirgüç-Kunt and Huizinga (2004), Baumann and Nier (2006), Gropp et al (2011)). Or else through expansion into business areas where the supported banks may have limited or no expertise (Jiménez and Saurina (2004)). Policy interventions, system-wide or targeted at individual institutions, are associated with distortions (Diamond and Rajan (2009), Farhi and Tirole (2012)). While system-wide interventions subsidise financing of unworthy projects by unconstrained banks (increasing their leverage), targeted ones involve "wasted-support" costs associated with information asymmetries (problems of distinguishing distressed from intact banks).

However, public recapitalisations may strengthen banks' monitoring incentives and reduce asset-substitution moral hazard by putting more equity at risk (Holmstrom and Tirole (1997), Mehran and Thakor (2011), Hellmann et al (2000)). Importantly, public recapitalisations are also designed to prevent bank failures, a breakdown of financial intermediation, bank runs, a loss of confidence in the financial sector and the therewith associated distress. Indeed, in the

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[5] An overview of announced packages is given in King (2009), with further detail and analysis provided in Panetta et al (2009), Petrovic and Tutsch (2009), and Borio et al (2010).

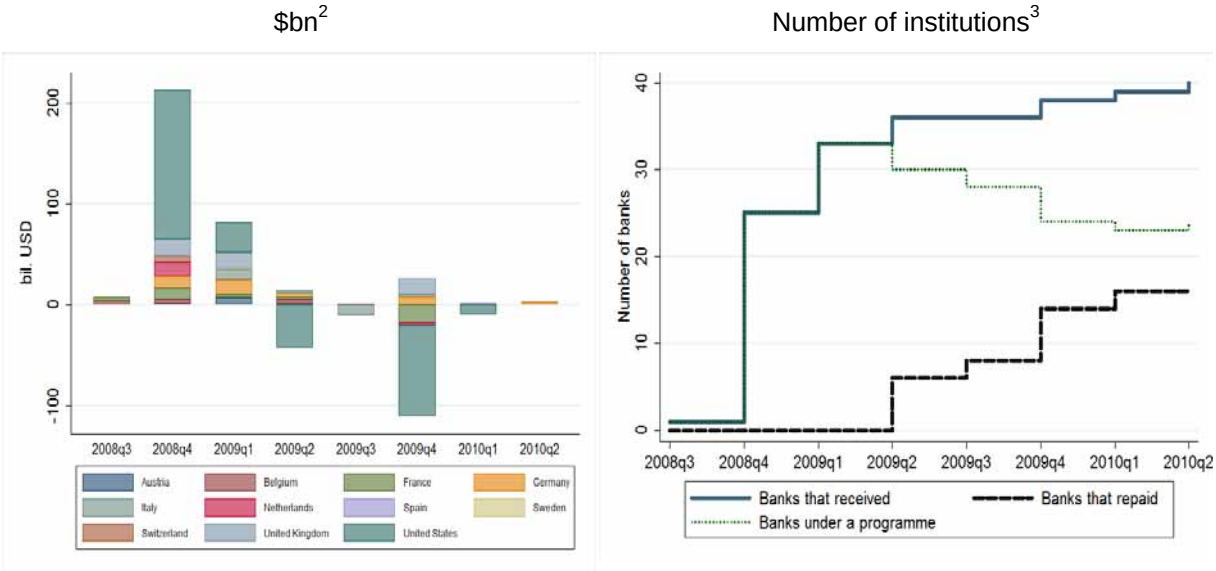
[6] The implicit guarantees of too-big-to-fail or too-interconnected-to-fail institutions tend to intensify incentives for banks to grow rapidly and to correlate their risk (Acharya and Yorulmazer (2007), Wagner (2008), Beck et al (2010), and Barrell et al (2011)). For a discussion of the negative externalities posed by large systemically important banks' size, interconnectedness, complexity, lack of substitutability or global scope, and the proposed policy responses, see BCBS (2011) and Beck et al (2010).

case of the recent financial crisis, which necessitated bank rescues world-wide to prevent a collapse of financial intermediation, it is argued that public interventions may have better aligned banks' incentives in terms of risk and generating returns. In particular, the interventions are likely to have been associated with increased regulatory monitoring (especially in the case of individually targeted bank rescues).

A number of empirical studies have investigated the link between state support or state ownership and bank risk (Hovakimian and Kane (2000), Jiménez and Saurina (2004), Gadanecz et al (2008), Hakenes and Schnabel (2010)). A positive link is generally found. Barrell et al (2011) and De Nicolò (2000) find a positive relationship between bank risk and size.

Figure 1

Capital raising from the public sector[1]



[1] At constant 2010 exchange rates; data up to July 2010. [2] Negative numbers: (net) repayments. [3] Number of institutions under a recapitalisation programme (number of institutions which received public funds minus those that repaid).

Sources: Central banks; Bloomberg; BIS calculations.

Our paper contributes to the extant literature in several respects. It is the first, to our knowledge, to analyse the relationship between bank bailouts and risk, allowing for double causality (see Section 3.2), using a large micro dataset of financial statements and loan transactions, and focusing on a sample of large internationally active banks. It complements a number of recent studies analysing bank behaviour around the time of the crisis and the bailouts. Those papers have utilised data from bank balance sheets (Berger et al (2011); Brei et al (2011)), micro loan transactions (Santos (2011)) and CDS spreads (King (2009)). In addition to the sample of banks that underwent public recapitalisation programmes, we also use a control sample of banks of similar size, which were not rescued, for comparison. Being free of national institutional features, and not subject to government pressure to lend to specific sectors, the international syndicated loan market provides a good context for the analysis of how state help may affect bank behaviour. Specifically, we test the following hypothesis:

- *Were the public rescues followed by a reduction of risk in banks' loan books?* By comparing the pre- and post-crisis risk of banks, rescued and non rescued, we seek to answer the question of whether one stated aim of the rescue packages, viz making the system safer, has been achieved.

2. Rescued versus non rescued banks: how different are they?

2.1 Obtaining a rich dataset of bank financial statements, loan portfolios and public bailouts

The analysis in this paper relies on two datasets, relating to bank financial statements and individual syndicated loan transactions, which have been combined with information on bank rescue measures. The data on financial statements were obtained from BankScope published by International Bank Credit Analysis Ltd. and Bureau van Dijk. Following Brei et al (2011), we consider the *consolidated* statements of major banks headquartered in the G10 countries plus Austria, Australia, Spain and Sweden. The decision to work with consolidated statements was made against the background that these banks operate on a consolidated world-wide basis and, importantly, that the public recapitalisations were injected into the consolidated entities rather than into subsidiaries or branches. The statements are annual, because most banks do not report consistently at a quarterly frequency over the sample period 2000–10. To avoid discontinuities in the financial statements caused by large acquisitions, we construct pro-forma banks by aggregating the reported positions of the acquiring and acquired banks prior to the take-over.

The data on financial statements was combined with information on financial sector rescue measures in selected economies (comprising 14 jurisdictions). The information on rescue packages was collected from public sources (eg news reports, official websites of national authorities, banks' media releases and investor relations materials) between October 2008 and September 2010. The measures include both system-wide and bank-specific programs. Our focus here is on individual bail-outs in the form of recapitalisations using state funds, arranged by the banks' home authorities. In so doing, we analyze the effects of taxpayers' money being used for rescue operations.

We merged the bank financial statement data with detailed information on banks' syndicated loan participations obtained from Dealogic Loan Analytics. That database provides information on syndicated loan facilities, such as loan size, terms, leverage, and type, as well as on a number of borrower characteristics including nationality, sector and credit rating. Information is also available on the identity of the banks that have participated in the syndications (allowing the merging with the BankScope data) as well as the amounts that they have committed (which makes it possible to calculate individual "portfolios" of syndicated loan signings for each bank). Roughly 84,000 loans have been recorded in the database for the period 2000–10 for our sample of banks, each comprising eight individual bank participations on average.

The matching of these datasets yields three attractive features for the analysis. First, a portfolio of syndicated loan participations can be constructed for each bank on the basis of information on individual loans.[7] This permits the calculation of the average characteristics of the loans included in a bank portfolio, for instance the average pricing of these exposures. Second, the behaviour of banks with different characteristics (eg those who have received a public recapitalisation versus those who have not) can be compared to detect different patterns in investment behaviour. In several instances, our measures, thus calculated, carry information about bank risk not contained in market-based proxies like CDS spreads, rating agency scores such as EDFs, or balance sheet indicators such as bad loans (see Section 2.3). Third, information on individual loan participations can be related to banks' balance sheet information and rescue status in order to investigate, at a micro-level, whether banks' characteristics are associated with specific patterns in their syndicated lending activities.

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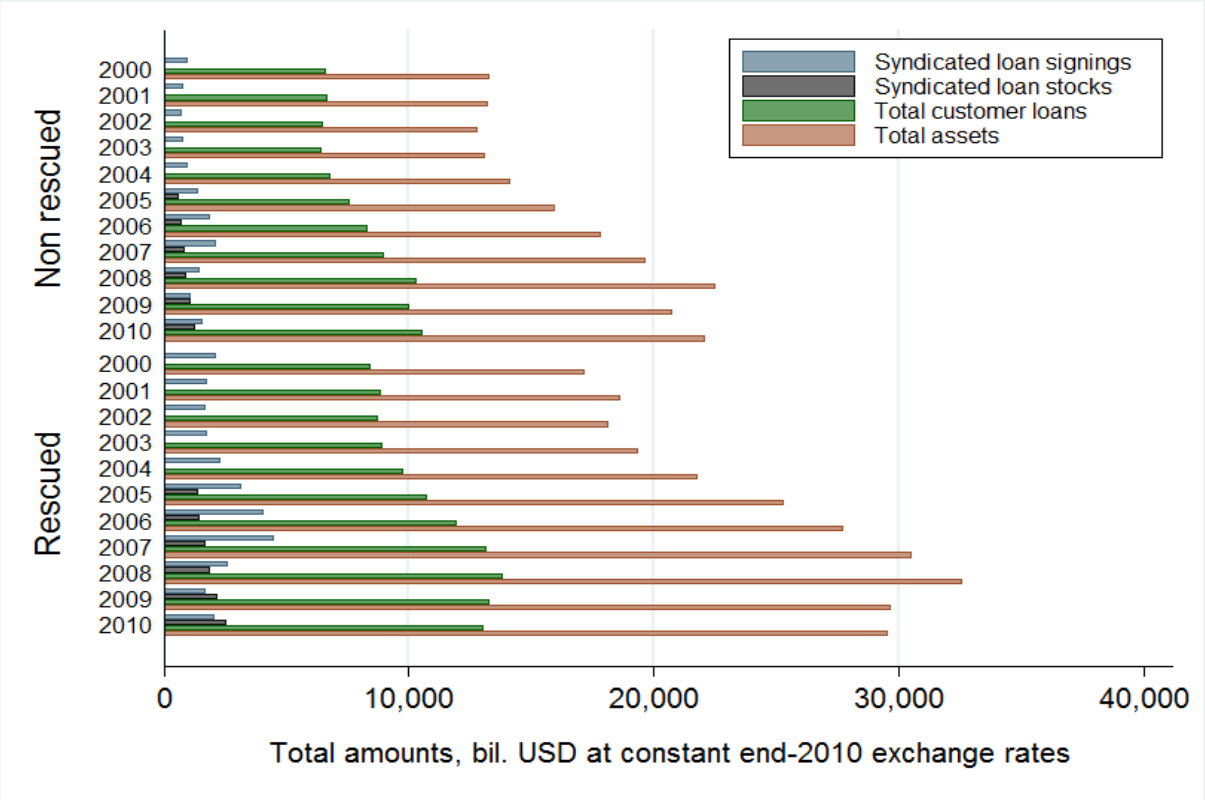
[7] Where banks' exact participation shares were not provided by Dealogic Loan Analytics, we assigned equal shares on any unallocated loan amounts, in line with the literature.

After controlling for mergers, acquisitions and missing data, our final sample comprises 87 bank holding companies.[8] For these institutions, both BankScope and Dealogic data are available, and they cover close to $53 trillion of bank assets which correspond to 52% of world-wide banking assets reported in *The Banker Magazine* at end-2010. Of these banks, 40 institutions (headquartered in 11 out of 14 countries, corresponding to 55% of the sample's total assets) have been subject to a public recapitalisation program between 2008Q3 and 2010Q2, see Figure 1. Total assets, individual customer loans, the issuance and the stock outstanding of syndicated loans in constant 2010 dollars for rescued and non rescued banks over the period 2000–10 are shown in Figure 2.

Figure 2

Syndicated loan signings, estimated stocks[1], outstanding customer loans and total assets



Notes: [1] estimated based on the assumption that every facility is drawn in full immediately upon signing and held to maturity with a bullet repayment at the end and no early repayments.

Sources: BankScope, Dealogic, authors' calculations.

2.2 Differences in the business

Syndicated lending makes up a significant part of banking activities for all banks our sample. Before the crisis in 2007, when the market for syndicated loans was booming, rescued and non rescued banks had total assets of $31 trillion and $22 trillion, respectively (see Table 1[9]

[8] A more detailed description of the construction of this dataset is provided in the Appendix.

[9] In Table 1, we also show whether selected indicators (ie those where statistical testing for differences is economically relevant) are statistically different across rescued and non rescued banks, or before versus during the crisis.

Table 1

Rescued and non rescued banks: balance sheet and syndicated lending[1]

	Rescued	***Rescued***	***Non rescued***	***Non rescued***	***Rescued***	***Non rescued***	***Total***
Number of banks	40	40	47	47	40	47	87
Bank specific characteristics (year-end)	***2007***	***2010***	***2007***	***2010***	***2010***	***2010***	***2010***
Assets ($ trillion)	31.29	28.78	21.82	23.82	28.78	23.82	52.60
Percentage of all assets	59	55	41	45	55	45	100
Deposits ($ trillion)	11.62	11.15	9.54	11.20	11.15	11.20	22.35
Percentage of all deposits	55	50	45	50	50	50	100
Loans ($ trillion)	13.57	12.50	10.00	11.21	12.50	11.21	23.71
Percentage of all lending	58	53	42	47	53	47	100
Synd. loan signings ($ trillion)	4.57	2.11	2.35	1.76	2.11	1.76	3.87
Percentage of all signings	66.04	54.52	33.96	45.48	54.52	45.48	100
Net income ($ trillion)	0.15	0.10	0.14	0.13	0.10	0.13	0.23
Percentage of all net income	52	43	48	57	43	57	100
Balance sheet ratios (period averages)	***2000–07***	***2008–10***	***2000–07***	***2008–10***	***2000–10***	***2000–10***	***2000–10***
Total loans relative to total assets (in %)	45.1	43.7	48.3	47.1	44.6***	47.9	46.0
Total deposits relative to total assets (in %)	39.2	37.5	46.7	45.3	38.6***	46.2	41.8
Liquidity (liquid assets over total assets, in %)	21.9**	25.2	18.9*	21.0	23.0***	19.6	21.6
Capital (equity over total assets, in %)	5.0	5.0	4.2	4.5	5.0***	4.3	4.7
Profitability (ROE, in %)	12.4***	–2.5	7.6	6.2	7.4	7.1	7.3
Impaired loans over total lending (in %)	2.0***	4.2	2.5	2.2	2.8**	2.4	2.6
Syndicated loan portfolio characteristics (period averages)	***2000–07***	***2008–10***	***2000–07***	***2008–10***	***2000–10***	***2000–10***	***2000–10***
Total synd. loan signings relative to total assets (in %)	11.9***	7.0	7.9***	6.5	10.3***	7.4	9.1
Share of home lending in synd. loan portfolio (in %)	36.0	37.4	31.9***	39.6	36.8	34.6	35.9
Share of leveraged loans in synd. loan portfolio (in %)	37.1	36.9	30.3***	24.9	37.0***	28.1	33.2
Average portfolio spread (bp)	145.9***	167.0	114.4***	84.0	150.7***	105.1	134.9
Average of borrower rating changes after signing (notches)	–0.7***	–0.4	–0.6***	–0.4	–0.7***	–0.5	–0.6
Average portfolio pricing error (bp)	–2.1	–1.7	1.1***	–4.9	–2.0	–0.7	–1.6
Average synd. loan size ($ billion)	0.07***	0.08	0.07	0.07	0.07	0.07	0.07
Average portfolio maturity (years)	4.7**	5.7	4.4	4.3	5.0***	4.4	4.8
Herfindahl Index (sectoral concentration)	1,469	1,490	1,499**	1,607	1,474**	1,532	1,495
Herfindahl Index (country concentration)	137	186	160	240	147	185	160
Share of loans with covenants in synd. loan portfolio (in %)	11.6**	10.2	9.6*	8.3	11.3***	9.2	10.6
Share of signings in foreign currency in synd. loan portfolio (in %)	37.50	40.7	70.2***	62.2	38.2***	67.8	48.5

[1] The sample period goes from 2000 to 2010 and includes 87 banks and 927 observations. Averages are weighted either by total assets or syndicated loan participations. "*Rescued banks*" denotes banks which have received a public recapitalisation during 2008-10, while "*non rescued banks*" indicates banks which did not receive such support. (***, **, *) indicate whether the weighted averages between two contiguous columns (rescued banks 2000–07 versus 2008-10, non rescued banks 2000–07 versus 2008-10, rescued versus non rescued banks, 2000–10) are significantly different at the 1%, 5%, and 10% levels, respectively.

Sources: BankScope, Dealogic, authors' calculations.

and Figure 2). Their syndicated loan exposure for that year (based on individual bank participation shares) represented 15% and 11% of total assets, respectively, while at end-

year, the stock outstanding of total customer loans (as reported by BankScope as part of the banks' balance sheets) made up 43% and 46% of total assets.[10]

Rescued banks have been relatively more active on the syndicated loan market. During the period 2000–10, their ratio of syndicated loan issuance (based on individual participations) to total assets stood at 10%, compared to 7% for non rescued banks. They also had a bigger share of total syndicated loan signings (55% versus 45% during 2000–10). Syndicated lending dropped sharply with the onset of the crisis in 2008 in the case of both rescued and non rescued banks, while the impact of the turmoil on customer lending only became apparent starting in 2009. The stock of outstanding customer loans of both non rescued and rescued banks shrank in that year, as did the total size of their balance sheets.

There are differences between rescued and non rescued banks in terms of size (Table 1). As of 2010, the 40 rescued banks have been larger as a group (total assets: $29 trillion) than the 47 non rescued banks ($24 trillion).

The business models also seem to differ. Over the whole sample, rescued banks had on average a significantly lower loan-to-asset ratio than non rescued banks (45% versus 48% of assets, respectively). That may either indicate that they engaged more in securities trading or in the securitisation of customer loans (Altunbaş et al (2009)). The liquidity ratio of rescued banks has been significantly higher (23%, versus 20% for non rescued banks), which could be related to the shorter-term nature of the trading business relative to the traditional lending business. It is interesting to note that the liquidity ratio of rescued banks increases significantly after the rescue operations, from 22 to 25%. On the liability side, rescued banks relied to a greater extent on non deposit funding (by 8% of assets during 2000–10), and had a slightly higher shareholders' equity to total assets ratio (the difference is 0.7% of assets) than non rescued banks. The crisis severely impacted the profitability of both rescued and non rescued banks. Not surprisingly, the financial crisis hit rescued banks most. The profitability (gauged by the ROE) of rescued institutions tanked during the crisis (from 12 to –3%), while it followed a more stable path (from 8 to 6%) in the case of non rescued banks. Likewise, rescued banks' ratio of impaired to total loans jumped more sharply during the crisis.

There is cross-country heterogeneity in the extent to which banks of various nationalities participate in loan syndications, as well as their degree of home bias (Table 2).[11] Relative to total assets, syndicated loan issues are most significant in Anglo-Saxon countries (19% of US banks' total assets, 11% for Canadian banks, 9% for British banks). Least involved have been Austrian, Belgian, Italian, and Swedish banks (below 5% of total assets in each case). Home lending is by far highest in the US where banks lent 79% of syndicated loans to borrowers that are as well headquartered in the US. On the other hand, banks from Belgium, Switzerland and Austria have been active mostly abroad, with home syndicated lending ratios of less than 10%.

[10] The database used for this paper only provides information on syndicated loan *signings*, not stocks outstanding of such loans. Nevertheless, knowing individual bank participation shares, and working with the assumption that every facility is drawn in full immediately upon signing and held to maturity with a bullet repayment at the end and no early repayments, it is possible to estimate stocks outstanding.

[11] In this paper we define home lending as cases where the ultimate nationality of the lender matches the ultimate nationality of the borrower. For instance, lending by any subsidiary of Deutsche Bank to any subsidiary of a German headquartered corporation would be considered as home lending. We use this definition mainly because public bailouts were conducted at the group level.

Table 2

Average bank features, by nationality of the parent bank (2000–10)[1]

Country	Total assets ($ billion)	Total synd. loan signings relative to total assets (in %)	Average[1] portfolio spread (b.p.)	Average[1] of borrower rating changes after signing (notches)	Share of leveraged loans in synd. loan portfolio (in %)	Share of home lending in syndicated loan portfolio (ultimate nationality basis, in%)	Share of home lending in syndicated loan portfolio (immediate nationality basis, in %)	Annual growth of total loans (in %)	Annual growth of synd. loan signings (in %)	No. of banks	No. of rescued banks	No. of obs. for the period 2000 –10
Austria	99.65	3.7	145.0	–0.29	44.7	7.6	11.0	13.7	56.8	5	5	52
Australia	191.80	6.8	32.8	–0.48	8.0	53.4	55.8	11.7	19.7	5	0	51
Belgium	500.20	4.6	106.5	–0.62	30.2	9.1	22.3	9.8	17.7	2	2	22
Canada	335.36	11.1	140.1	–0.74	24.1	38.4	45.0	6.5	9.5	6	0	66
Switzerland	770.21	5.7	262.8	–0.54	33.4	6.1	12.6	2.1	17.8	4	1	44
Germany	580.09	7.1	122.3	–0.59	28.7	21.0	25.4	3.3	9.5	10	3	105
Spain	237.93	5.2	82.3	–0.62	20.3	35.2	46.0	10.2	46.0	11	1	111
France	1,283.07	8.7	110.1	–0.48	27.3	22.3	26.0	10.7	6.9	4	4	42
Italy	281.74	4.1	109.9	–0.81	26.5	35.2	39.2	2.4	24.4	10	5	109
Japan	722.97	7.4	39.1	–0.40	19.0	46.5	51.5	–1.6	15.4	4	0	42
Netherlands	828.36	6.4	151.1	–0.66	31.7	14.1	19.1	11.0	27.4	2	2	19
Sweden	304.99	4.5	81.0	0.04	35.3	26.2	29.7	7.5	54.7	4	1	44
United Kingdom	1,252.15	9.4	125.5	–0.63	31.3	20.1	25.5	8.0	5.0	4	2	44
United States	450.43	19.3	177.8	–0.72	31.0	79.3	79.9	5.3	5.2	16	14	176
Average/sum*	7,838.95	7.4	120.5	–0.54	28.0	29.6	34.9	7.2	22.6	87*	40*	927*

[1] Weighted by participation amounts. "***Average/sum****" in the last row indicates unweighted averages or sums (*) over the countries' averages or numbers of observations.

Sources: BankScope, Dealogic, authors' calculations.

There are no statistically significant differences between rescued and non rescued institutions' shares of syndicated lending to their home countries. The average score for the period 2000–10 is 36% (Table 1). Nor is there a statistically significant difference in the home bias before and after the crisis for rescued institutions. It is true that the market for syndicated loans is by definition very international. Even so, if any state help was provided with the understanding, implicit or explicit, that rescued institutions should increase their lending at home,[12] in order to prevent domestic credit crunches, this does not seem to have happened on this particular market segment.

The sectoral and country concentration of rescued banks' loan signing portfolios does not differ significantly from that of non rescued banks. We have calculated Herfindahl indices to gauge the sectoral and country concentration of banks' syndicated lending activities. We have classified the 214 base borrower sectors supplied by Dealogic into the 11 sectors of the FTSE classification system.[13] We have used the 240 borrower nationalities available in the Dealogic database. For each bank and each year, we have calculated the relevant sectoral and country Herfindahl index.[14] The important message here is that in terms of *country concentration,* there are no significant differences between rescued and non rescued banks, nor any significant differences in the concentration of the portfolio before and after the crisis. With respect to *sectoral concentration*, rescued banks' portfolios have been slightly less concentrated than non rescued banks' for the whole period 2000–10. The sectoral concentration of non rescued banks' portfolios increased slightly with the onset of the crisis, while that of rescued banks remained virtually unchanged.

2.3 Were rescued banks riskier than non rescued banks?

The riskiness of rescued banks' syndicated lending appears to be significantly higher than that of non rescued banks (Table 1 and Figure 3). As a first gauge for this, we divided loans into three categories: highly leveraged, leveraged[15], and not leveraged. In the run-up to the crisis, the share of leveraged or highly leveraged loans increased steadily from 25% of total signings at end-2000 to 52% in the case of rescued banks compared to 43% in the case of non rescued banks at end-2007 (Figure 3, top left panel). It appears that banks that were subsequently rescued had engaged in riskier syndicated loan arrangements before the crisis compared to the control group. Both rescued and non rescued banks decreased their participation in leveraged or highly leveraged loans with the onset of the crisis. Admittedly, this could be related to the collapse of the leveraged loan market during the crisis (Chui et al

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[12] For instance, the French state's capital injections of 2008 and 2009 into six French banks came with commitments from the banks to increase lending to the French economy by 3 to 4% a year over a given time horizon. Similarly, the recipients of TARP funds in the US have been encouraged to increase lending at home in the risky crisis environment.

[13] Defined as: basic industry, cyclical consumer goods, cyclical services, financials, general industries, government/sovereign, information technology, non-cyclical consumer goods, non-cyclical services, resources, utilities.

[14] The Herfindahl-Hirschman Index for the country (resp. sectoral) composition has been calculated as follows: $HHI_{it} = \sum(100 \times Z_{ijt})^2$, where Z_{ijt} is the share of bank *i*'s lending to country (resp. sector) *j* in year *t* – based on the ultimate borrower nationality for the country measures. Overall, our sample of banks (headquartered in 14 countries) lent to borrowers from 161 countries.

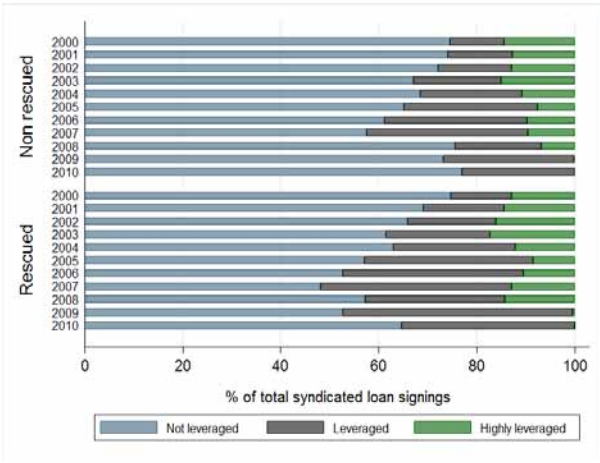
[15] We rely on the definition of Dealogic Loan Analytics for leveraged loans. They revise their definition every year, and over time the criteria have included borrower financial leverage and loan spreads above a certain threshold, ratings below a certain level, and loan purpose (especially LBOs). Every loan is classified according to the definition which was valid when it was signed. It is not possible to reclassify earlier loans when the definition changes. For signings after 2008, Loan Analytics ceased to distinguish between highly leveraged and leveraged loans. From that time on, only leveraged versus non-leveraged status is reported. The highly leveraged category used to apply to facilities carrying spreads above a certain benchmark.

(2010)). However, the decrease has been more pronounced in the case of non rescued banks (to 25% of their total syndicated loan participations at end-2010, while it reached 37% in the case of rescued banks at that time, a statistically significant difference).[16]

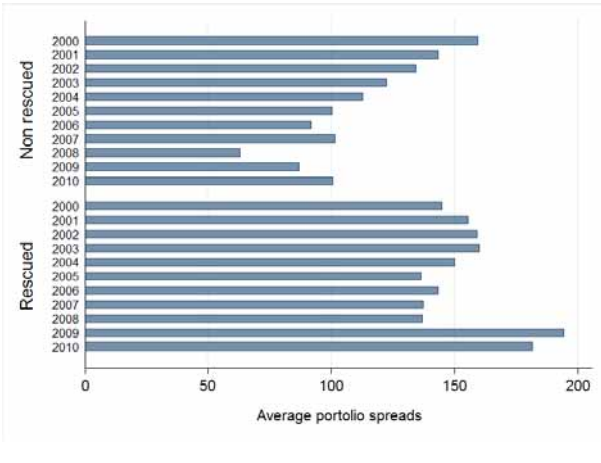
Figure 3

Risk in the syndicated loan market by bank type

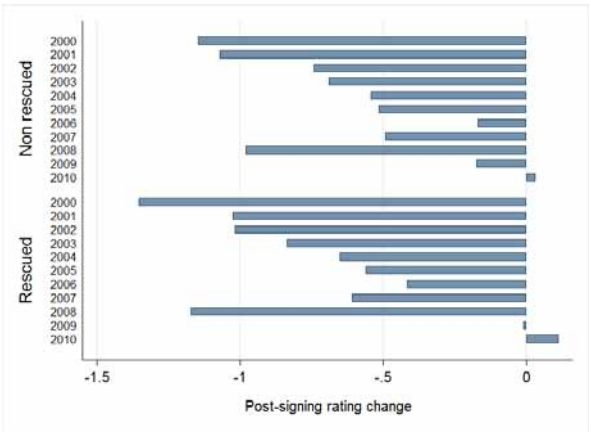
Loan leverage[1] classification in portfolio



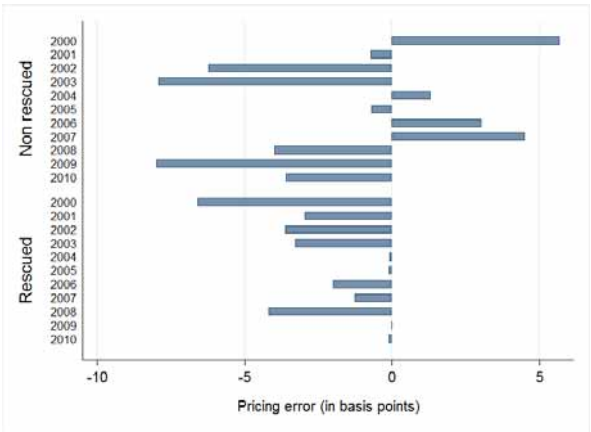
Average[2] portfolio spread



Average[2] post-signing rating change[3] in portfolio



Average[2] portfolio pricing error[4]



Notes: [1] In % of participation amounts. The category "highly leveraged" was merged with the "leveraged" category in 2009. [2] Weighted by loan participation amounts. [3] Difference (in notches) between the borrower's current rating and the rating at signing, with the higher scores corresponding to better ratings. As such, a score of +2 should read as an average post-signing upgrade of two notches in the portfolio. [4] Difference between the observed spread over Libor, and the spread predicted by a linear regression incorporating observable loan features (size, maturity, guarantees, collateral, facility purpose and type), borrower characteristics (sector, rating, first time borrower) and the state of the market (total volumes, level of interest rates).

Sources: BankScope, Dealogic, authors' calculations.

[16] Likewise, average loan maturities have been statistically significantly higher in rescued banks' portfolios of loan signings (5 years versus 4 years for non rescued institutions for the period 2000–10), with rescued banks' average maturities decreasing less significantly with the onset of the crisis than in the case of non rescued banks.

The second main risk indicator, namely average Libor spreads in banks' portfolio of syndicated loan signings, confirms this difference in risk. The large share of leveraged and highly leveraged loans in rescued banks' syndicated loan portfolios has been associated with higher average portfolio spreads, before and after the crisis.[17] The average spreads (weighted by participation amounts) in rescued banks' portfolios of loan signings were significantly higher than in non rescued banks' portfolios, before the crisis (for the period 2000-07; 146 versus 114bp, respectively, see Table 1) and during the crisis (2008-2010; 167 versus 84bp).

Lastly, borrowers who had been granted syndicated loans by rescued banks were subsequently downgraded to a greater extent than borrowers who had received loans from non rescued institutions (Figure 3, bottom left panel). Again, this points to rescued banks' more relaxed attitude towards risk.

We also looked at the "pricing error" on the loans relative to a benchmark. Following Carey and Nini (2007) and Gadanecz et al (2008), the errors were calculated by taking the difference between the observed spread over Libor, and the spread predicted by a linear regression incorporating observable loan features (size, maturity, guarantees, collateral, facility purpose and type), borrower characteristics (sector, rating, first time borrower) and the state of the market (total volumes, level of interest rates). The average values, calculated every year in every bank's portfolio (weighting by the participation amounts) are reported under "average pricing errors" in Table 1 and Figure 3 (bottom right panel). Negative (positive) pricing errors suggest that risk is "underpriced" ("overpriced") according to this model. It is interesting to note that before the crisis, rescued institutions had been participating in facilities that were systematically more underpriced (in the sense of being below a benchmark predicted by observable risk factors) than non rescued ones. In response to the crisis and particularly during 2009-10, however, rescued banks aligned their pricing to better reflect the observed risk factors, although the increase is not statistically significant.

To summarise, the above analysis points to significantly more risk in the loan books of rescued banks than of non rescued banks before and during the crisis. This is not reflected in CDS spreads, EDF measures or non-performing loan ratios, which have in a number of years preceding the crisis been higher for non rescued banks than for rescued banks (Figure 4). We surmise that because CDS spreads incorporate the expectation of getting a public bailout, they can be lower in the case of rescued (or implicitly guaranteed) banks before the rescues happened. Furthermore, inflated equity prices during the period preceding the crisis may have contributed to excessively low expected default probabilities. As far as non-performing loan ratios are concerned, non rescued banks may have been more diligent in recognising them than their rescued peers.

In the next section, we substantiate these results by means of a more rigorous econometric analysis. We look for the determinants of banks' riskiness, including balance sheet characteristics, macro factors, and the crisis itself, allowing for the possibility that bailouts are endogenously determined.

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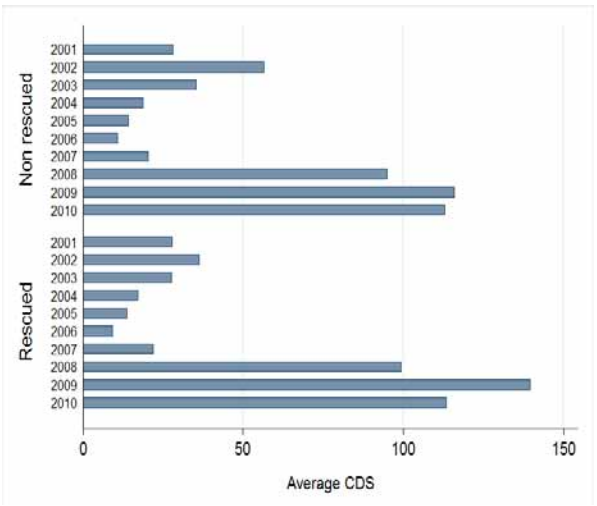
[17] All other things equal, a higher spread can be interpreted as an indicator for the default probability of borrowers. The actual spread depends typically on the creditors' assessment of borrowers' capacity and willingness to repay the loan. It has been shown in the literature that such risk premia depend on both internal factors that characterize borrowers' and lenders' financial strength and growth perspectives, and external factors such as the macroeconomic environment and the stance of the global capital market (Bernanke, Gertler and Gilchrist (1999)). Information asymmetries, which are often proxied by existing lender-borrower relationships, public listing of borrowers and geographical distance, are important determinants as well, since they increase the problems associated with moral hazard, risk shifting, and adverse selection (Hellmann et al (2000), Kahn and Winton (2004), and Akerlof (1970)).

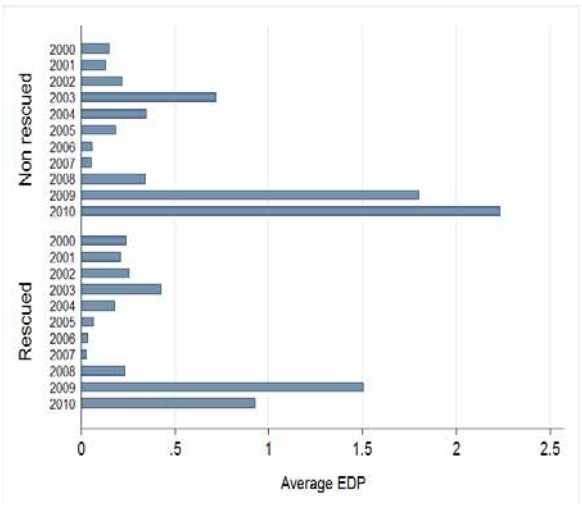
Figure 4

Alternative measures of bank riskiness

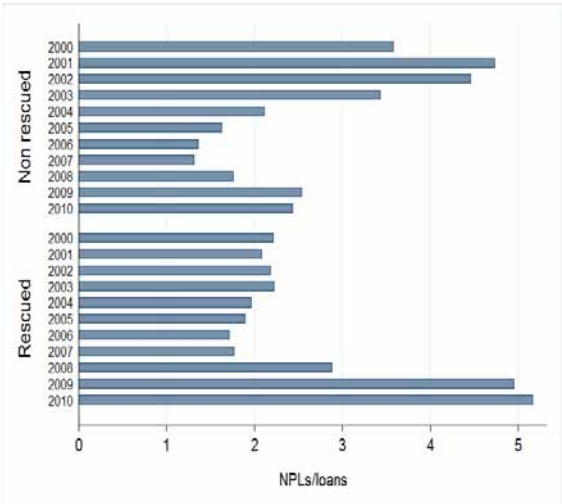
CDS spreads[1, 2]



EDFs[1, 3]



Non-performing loans to total loans[4]



Notes: [1] Weighted by total assets. [2] In bps, on 5-year CDS contracts. [3] Weighted average of expected probabilities, in %, that the rescued vs non rescued banks will default within one year. [4] In %.

Sources: BankScope, Markit, Moody's, authors' calculations.

3. Were public bailouts followed by a reduction in risk?

3.1 Simple estimates

In this section, the key question we wish to test econometrically is whether public bailouts were followed by a reduction in banks' risk profile. To do this, we set up a model to estimate the determinants of bank risk, among them public rescue operations and the advent of the crisis. This can be expressed with the following equation:

$$Risk_{it} = (\alpha_N + \alpha_{N,C} C_t) + (\alpha_R + \alpha_{R,C} C_t) R_i + \gamma Z_t + \delta X_{it-1} + u_i + \varepsilon_{it},$$

where $Risk_{it}$ denotes our indicator of risk for every bank *i* during financial year *t*, u_i unobserved fixed- or random-effects, and ε_{it} the error term. Specifically, we use two proxies for risk: the share of leveraged loans in the bank's portfolio of syndicated loan signings, and the average Libor spread (weighted by participation amounts) in its portfolio of syndicated loans for that year. C_t is a dummy variable that is equal to one during the period of the global financial crisis, which we define as the period 2008-10, and zero otherwise. R_i is a dummy variable which we set to one over the entire sample period if bank *i* was rescued during the financial crisis.

This rescue dummy variable and its interaction with the crisis dummy allow us to distinguish rescued banks from the control group, before and during the crisis (as discussed below). Vector X_{it-1} corresponds to a set of bank-specific control variables (discussed in greater detail in Box 1 of the Appendix). From the balance sheets, these include bank capital, liquidity, size, profitability, and market funding. Total syndicated loan signings, together with country and sectoral concentration indices of the signing portfolios, and the share of signings in foreign currency or with covenants, were also employed. Moreover, we included a dummy variable that is equal to one in the years when banks report under a different accounting standard (many banks changed in 2005 from local GAAP to IFRS). Because of endogeneity concerns, the bank and syndicated loan characteristics have been lagged by one year. In several model specifications, we interacted the bank balance sheet and syndicated loan variables with the crisis dummy, in order to allow for possible changes in the slope coefficients before and during the crisis. The bank-specific variables are de-meaned, implying that the results can be interpreted in terms of the average bank. Vector Z_t comprises time-fixed effects that control for time-varying changes in aggregate lending and macroeconomic conditions.

For the purposes of testing for any heterogeneity in risk between rescued and non rescued banks, the key coefficients are those associated with the constant, the crisis dummy C_t, the rescued banks dummy R_i, and their interaction.[18] In particular, the coefficient α_N can be interpreted as the risk of the average non rescued bank during normal times ($C_t = 0$ and $R_i = 0$), after controlling for aggregate macroeconomic conditions and bank-specific characteristics. The sum of coefficients $\alpha_N + \alpha_{N,C}$ can be understood as the average risk response during the crisis by the average non rescued bank ($C_t = 1$ and $R_i = 0$). When the coefficient $\alpha_{N,C}$ is significantly different from zero this means that the risk of non rescued banks has changed in response to the crisis. If there are significant differences in risk between rescued and non rescued banks during normal times ($C_t = 0$ and $R_i = 1$), the coefficient α_R should be significantly different from zero. The overall risk of the average rescued bank in normal times would be $\alpha_N + \alpha_R$. When the risk of rescued banks is different from that of non rescued banks during the crisis ($C_t = 1$ and $R_i = 1$), we should find that the coefficient $\alpha_{R,C}$ is significantly different from zero.

Table 3 contains definitions and summary statistics of the variables, while their expected signs are summarised in Table 4 and discussed in Box 1 of the Appendix.

[18] Brei et al (2011) follow a similar approach.

Table 3

Regression variables: definitions and summary statistics[1]

Variable name	Variable description	Units	Number Observations	Mean	Std. Dev.	Min.	Max.
	Endogenous variables						
Leveraged loan$_t$	Dollar share of leveraged loans in portfolio of signings	%	927	33.2	21.1	0	100
Spread$_t$	Average spread in portfolio of signings	Bp	924	134.9	65.2	1.0	438.1
	Bank-specific characteristics in vector X						
Capital$_{t-1}$	Equity over assets	%	960	5.8	2.9	0.6	16.8
Loan growth$_{t-1}$	Growth rate of loan book	%	862	8.1	13.3	–45.1	77.8
ROE$_{t-1}$	Return on equity	%	959	9.2	17.8	–269.2	45.7
Liquidity$_{t-1}$	Liquidity ratio (liquid assets over total assets; liquid assets defined as cash and due from banks, available for sale securities, and trading securities and at fair value through in income.	%	872	0.7	6.8	–29.0	55.7
Size$_{t-1}$	Logarithm of total assets (Ln($bn))	%	960	5.4	1.3	1.8	8.2
MFund$_{t-1}$	Reliance on market funding (non-deposit funding over assets)	%	958	48.6	17.7	10.4	94.9
	Syndicated loan characteristics in vector X						
Signings$_{t-1}$	Signings of syndicated loans over total assets	%	848	8.0	8.6	0.1	70.9
Signings growth$_{t-1}$	Growth rate of syndicated loan signings	%	757	14.9	68.5	–97.7	486.1
Rating change$_{t-1}$	Average of borrower rating changes after signing in portfolio of synd. Loans	notches	848	–0.5	1.0	–6.0	5.0
HHI (sectors)$_{t-1}$	Herfindahl Index on sectoral concentration divided by 100	Index	848	24.9	19.2	11.2	100
HHI (countries)$_{t-1}$	Herfindahl Index on country concentration divided by 100	Index	848	14.4	27.7	0.1	100
FX signings$_{t-1}$	Share of signings in foreign currency in synd. loan portfolio (loan currency different from lender bank's home currency)	%	848	41.1	33.6	0	100
Covenants$_{t-1}$	Share of loans with covenants (in respect of current ratio or net worth) in synd. loan portfolio	%	848	0.5	1.3	0	16.7
Maturity$_{t-1}$	Average maturity in portfolio of signings	Years	848	4.9	2.2	1.2	18.2

Other controls							
R_i	Dummy that takes the value of 1 over the entire sample period when a bank has been rescued	Dummy	1,056	0.4	0.5	0	1
C_t	Dummy that takes the value of 1 in the years 2008-10 and 0 elsewhere	Dummy	1,056	0.2	0.4	0	1
Accounting change$_t$	Dummy that takes the value of 1 if a bank changed from LGAAP to IFRS and thereafter	Dummy	1,056	0.4	0.5	0	1
Memo: Macroeconomic controls in Logit regression to estimate the probability of a public bailout							
GDP growth$_{t-1}$	Growth rate of GDP	%	968	4.0	3.0	–6.1	9.6
Δ *Interest rate*$_{t-1}$	Year-on-year change in the three-month interbank rate (3-month maturity)	%	968	–2.9	1.3	–4.3	1.9
Stock price growth$_{t-1}$	Year-on-year stock price growth	%	968	2.3	19.2	–36.2	46.0
House price growth$_{t-1}$	Year-on-year house price index growth	%	968	5.1	6.4	–10.9	25.2

[1] The sample period goes from 2000 to 2010. Portfolio averages are weighted by participation amounts.

Sources: BankScope, Dealogic, authors' calculations.

Table 4

Determinants of bank bailouts and risk – expected coefficient signs

Variable	Expected sign	Interpretation or literature reference
Bank characteristics		
Capital (equity over assets)	+/–	More capital means a larger cushion to absorb losses, so a lower need for bailouts. However, through the capital ratio, a larger capital base allows to take on more risk (Schaeck and Čihák (2011)).
Profitability (ROE)	+/–	More profitable banks are less likely to need a bail-out, they can also build up capital by retaining earnings. But high profitability may simply reflect a riskier portfolio.
Liquidity (liquid assets over total assets)	+/–	Liquid assets serve as a cushion to meet obligations; however, holding liquid assets is costly and can negatively impact profitability. Low-yielding liquid assets may also provide an incentive to search for yield.

Size (logarithm of total assets)	+/–	Large banks have more capacity to absorb country and sector-specific shocks, but they are more likely to be bailed out because of their size (a measure of systemic importance), and may also adopt a more relaxed attitude towards risk.
Relative importance of (syndicated) lending	–	Syndicated lending is a traditional business line that tends to generate a stable revenue stream. Sharing risk with other banks through syndication presumably also reduces risk.
Loan growth	+	Lending booms can be advance indicators of crises, so the growth of the bank's loan book is expected to be positively related to risk and bailouts.
Reliance on market funding (non-deposit funding over assets)	+/–	Market funding can serve as an additional funding source in times when it is difficult to obtain client deposits; however, reliance on market funding also makes the bank more vulnerable to a dry-up of liquidity from money market funds or on the interbank market
Characteristics of the syndicated loan portfolio (average values – weighted by participation amounts – for a given year and a given bank)		
Share of leveraged loans in portfolio of signings	+	Since leveraged loans are more risky, they can be associated with higher losses.
Signings growth	+	Lending booms can be advance indicators of crises, so the growth of syndicated loan signings by the bank is expected to be positively related to risk and bailouts.
Average of borrower rating changes after signing in portfolio of syndicated loans	–	Post-signing borrower upgrades are associated with higher profits and fewer losses.
Average portfolio spread	+	Higher spreads can mean riskier borrowers; more lending to them can be associated with higher losses.
Average portfolio maturity	+	Greater maturities can mean taking on risks for a longer period of time, higher maturity transformation in respect of liabilities and possibly more significant losses.
Share of home lending in syndicated loan portfolio	–/+	Lenders presumably know the home business better, therefore more home lending means less risk. However, authorities may be more likely to bail out domestic institutions.
Syndicated loan portfolio concentration	+/–	Loan portfolio concentration may increase the cost-efficiency of monitoring (Winton (1999), Rossi et al (2009), Tabak (2011)). Nevertheless, diversification increases profit efficiency (GarcíaGarcía-Herrero and Vazquez (2007), Rossi et al (2009)).
Share of loans with covenants in syndicated loan portfolio	+/–	By mechanically triggering penalties if the borrower fails to meet certain obligations or gets a rating downgrade, covenants offer more protection to the lender. However, they mechanically also trigger more defaults.
Share of loans in foreign currency in the portfolio of signings (currency of loan different from lender bank's home currency)	+	Less FX hedging could mean more risk for the bank.

Table 5

Rescue status and risk[1]

Dependent variable:	*Leveraged loans$_t$*		*Leveraged loans$_t$*		*Spread$_t$*		*Spread$_t$*	
	R1		R2		R3		R4	
	Hausman Taylor		Hausman Taylor		Hausman Taylor		Hausman Taylor	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Constant	35.57***	3.29	35.25***	3.41	96.1***	10.49	91.12***	10.72
Constant*C_t	–11.34***	2.19	–11.16***	2.21	–8.32	6.14	–8.57	5.98
R_i	9.04**	4.06	8.81**	4.22	39.2***	13.61	38.51***	14.01
R_i*C_t	7.16***	2.30	6.78***	2.48	37.5***	6.45	33.13***	6.73
Capital$_{t-1}$	–0.70	0.48	–1.19**	0.53	–3.08**	1.40	–4.34***	1.48
ROE$_{t-1}$	–0.04	0.03	–0.02	0.04	–0.09	0.09	–0.04	0.12
Liquidity$_{t-1}$	–0.01	0.07	–0.02	0.07	–0.24	0.19	–0.28	0.21
Size$_{t-1}$	–0.33	1.60	0.63	1.71	–2.15	5.04	–1.47	5.25
MFund$_{t-1}$	0.01	0.09	0.01	0.10	–0.33	0.28	0.02	0.29
Signings$_{t-1}$	0.16	0.11	0.14	0.12	–0.22	0.31	–0.04	0.33
HHI (sectors)$_{t-1}$	–0.21***	0.06	–0.19***	0.06	–0.15	0.17	–0.06	0.18
HHI (countries)$_{t-1}$	0.03	0.04	0.06	0.04	0.041	0.11	0.11	0.12
FX signings$_{t-1}$	–0.002	0.04	–0.01	0.04	0.29**	0.12	0.33***	0.12
Covenant $_{t-1}$	0.37	0.44	0.51	0.64	2.81**	1.23	5.27***	1.72
Capital$_{t-1}$*C_t			1.34**	0.56			2.40	1.54
ROE$_{t-1}$*C_t			–0.06	0.06			–0.29*	0.17
Liquidity$_{t-1}$*C_t			0.18	0.12			1.10***	0.34
Size$_{t-1}$*C_t			–3.10**	1.37			–4.59	3.72
MFund$_{t-1}$*C_t			0.01	0.08			–1.02***	0.23
Signings$_{t-1}$*C_t			0.23	0.18			0.47	0.48
HHI (sectors)$_{t-1}$*C_t			–0.04	0.10			0.03	0.29
HHI (countries)$_{t-1}$*C_t			–0.12*	0.06			–0.32*	0.18
FX signings$_{t-1}$*C_t			0.03	0.05			–0.19	0.13
Covenant $_{t-1}$*C_t			–0.40	0.89			–6.05**	2.40
Accounting change	–2.95	2.04	–2.00	2.13	–7.60	5.79	0.53	5.85
Time fixed-effects	In		In		In		In	
Observations	830		830		830		830	
Rho	0.58		0.61		0.68		0.71	
Wald statistic	97.18		124.71		120.40		209.61	

[1] The sample period goes from 2000 to 2010. The dependent variable leveraged loans in regressions R1-R2 is equal to the percent share (in terms of the dollar amounts of participations) of *leveraged loans* in the portfolio of signings of each bank for each year. The dependent variable *spread* in R3-R4 is equal to the average spread (in basis points, weighted by participation amounts) of the portfolio of syndicated loan signings of each bank for each year. The *rescued banks* dummy variable R_i is equal to one over the entire sample period when a bank received a public rescue during 2008-10. The crisis dummy variable C_t is equal to one during 2008-2010, and to zero in previous years. The estimations have been done using the Hausman-Taylor estimator. Robust standard errors are reported. "Rho" is the share of the estimated variance of the overall error accounted for by fixed effects, and "Wald statistic" denotes the test statistic for the overall significance of the coefficients. (***, **, *) indicate significance at the 1%, 5%, and 10% level. Independent variable definitions: see Table 3. Syndicated loan variables are averages (weighted by participation amounts) taken for banks' portfolios of signings every year.

Sources: BankScope, Dealogic, authors' calculations.

We based the selection of the estimation method on a number of statistical tests. The choice between the random- and fixed-effects estimator was based on the Hausman test using different sets of regressors. In all cases, the Hausman test rejected the null hypothesis that the unobserved effects are uncorrelated with the explanatory variables, implying that the random-effects estimator is inconsistent. The fixed-effects estimator would therefore be the appropriate estimator. One problem arises, however, namely that our model includes both the time-invariant rescued banks dummy, R_i, and the time-invariant unobserved fixed effects. As a result, the rescued banks dummy would drop out because of its collinearity with the fixed-effects, making it impossible to estimate the α_R coefficient (differential risk of rescued banks prior to the crisis). We therefore used the Hausman-Taylor estimator which allows estimating fixed-effects models that include time-invariant explanatory variables (Hsiao (2004)).

The results of this first, simple estimation approach show that, before and during the crisis, the average rescued bank's syndicated lending activity was riskier than that of the average non rescued bank. The results are reported in Table 5 with various combinations of the dependent and independent variables. The share of leveraged borrowers in rescued banks' portfolios for the period 2000–10 has been significantly higher by nine percentage points than that of non rescued banks (regressions R1 and R2), and they held loans with higher spreads (on average, by 39bps during the same period, regressions R3 and R4).

We also find *prima facie* evidence that relative to that of non rescued banks, the risk of rescued banks did not diminish significantly during the crisis.. We controlled for any change in rescued banks' behaviour relative to that of non rescued banks with the advent of the crisis by interacting the crisis dummy with the rescue dummy. In all model specifications, the interaction term turns out significant and positive (7 percentage points more leveraged borrowers in the portfolio; weighted average spread higher by 33–37bps in the portfolios than for non rescued institutions. This suggests that rescued banks did not reduce their loan risk relatively more than non rescued banks in response to the crisis, but appeared to continue to add to it.

3.2 Allowing for the endogeneity of bailouts

Our first, simple approach, however, does not capture the fact that bailouts may be endogenously determined. The causal relation may be that a rescued bank has taken on more risk *ex ante* than a non rescued bank, insofar as it was expecting to be rescued (the moral hazard argument). Conversely, excessive risk taking may have necessitated a bailout. We take the latter hypothesis to the data and estimate by means of a logit regression the probability of getting a public bailout as a function of macroeconomic control factors, and predetermined bank-specific information. The latter includes data from the financial statements, and various average measures based on the banks' syndicated loan portfolio, and importantly, exogenous factors not included in the main regression in Section 3.1.[19] We do find that rescue probabilities are significantly determined by bank profits, size, liquidity and capital, as well as leverage, maturity and concentration and currency mismatches in the syndicated loan portfolio (results reported and discussed in further detail in Box 2 of the Appendix; see Table A1). Various macro controls, such as stock- and house price growth, also turn out to be significant. The fact that public rescues are significantly determined by bank risk is an endogeneity problem biasing our results of Section 3.1 which, as such, should be interpreted with caution.

As a remedy for the endogeneity of bailouts, we use the logit regression reported in Table A1 to derive a valid instrument for the public rescues in our main regression. This strategy is

[19] eg yearly growth rate of banks' loan books; house price growth.

often referred to as an instrumental variable approach and has also been used by Santos (2011) in respect of bank losses and loan spreads. Our logit regression identifies 37 institutions with a probability of at least 50% of being rescued during the crisis out of the total of 87 banks (of which 40 have actually been rescued). In 27 cases the rescues have been correctly identified, while in 10 cases there was a high probability of being rescued although nothing happened.[20] These 37 banking institutions represent our instrument set of rescued banks. In this section, we define two versions of the instrumented rescue variable based on these results: a time-variant and a time-invariant one. The time-invariant version $\hat{R}_i$ is set to one over the entire sample period (2000–10) if bank *i* had a predicted probability of being rescued of at least 50% during the financial crisis. This allows us to disentangle differences in risk profile across rescued and non rescued banks prior to and in response to the financial crisis. The time-variant (forward-looking) version $\hat{R}_{it}$ is set to one in the year when a bank had a predicted probability of being rescued during the financial crisis of at least 50%, *as well as in the years thereafter.*

Our revised model specification now seeks to answer the question: once other bank characteristics, macro factors, *and the endogeneity of public bailouts* are controlled for, has rescued banks' risk been higher than that of non rescued banks prior to the crisis and has it decreased in response to the crisis? The version of the new model with time-invariant instruments can be written as:

$$Risk_{it} = (\alpha_N + \alpha_{N,C} C_t) + (\alpha_R + \alpha_{R,C} C_t)\hat{R}_i + \gamma Z_t + \delta X_{it-1} + u_i + \varepsilon_{it},$$

and the one with time-varying instruments as:

$$Risk_{it} = (\alpha_N + \alpha_{N,C} C_t) + (\alpha_R + \alpha_{R,C} C_t)\hat{R}_{it} + \gamma Z_t + \delta X_{it-1} + u_i + \varepsilon_{it}.$$ [21]

Results with time-invariant instruments

As before, we experimented with various combinations of bank balance sheets and loan portfolio factors (results are reported in Tables 6 and 7). We focus the discussion here on our preferred model specifications R7 and R11, as they allow for a shift in the parameters during the crisis (though variations around them being broadly similar). Taking the endogeneity of public rescues into account, we confirm that rescued banks have been significantly riskier before and during the crisis. The coefficients associated with the $\hat{R}_i$ variable are significant and positive. Rescued banks' portfolio share of leveraged syndicated lending has been higher by 8 percentage points than that of their non rescued peers (regression R7), and they had an average portfolio spread which was higher by 54bp (R11). These differences, measured at the bank portfolio level, are quite significant, both statistically and economically: the spread surcharge is roughly equivalent to the additional Libor spread paid when a borrower is downgraded from BB to B, other things being equal. The results also corroborate the average portfolio characteristics of rescued and non rescued banks shown in Table 1 and in Figure 3, as discussed in Section 2. However, the additional risk of rescued banks during

[20] Among the 10 "false alarms" are some banks that were offered money by the government but turned it down due to reputational concerns. Some institutions received a private sector bailout instead. Our type 1 errors also include rescued institutions for which our model does not predict a public bailout. Even though they may have been intrinsically sound taken on their own, the authorities may have forced them to take state funds because of their interconnectedness with other banks, the rest of the financial system and the real economy.

[21] The version using a time-varying version of the instrumented rescue variable is also known as a *treatment regression.*

Table 6

Determinants of bank loan risk – Share of leveraged loans in portfolio of signings[1]

Dependent variable:	R5		R6		R7		R8	
	Hausman Taylor		Hausman Taylor		Hausman Taylor		Fixed effects	
Leveraged loans$_t$	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Constant	37.56***	3.08	37.26***	3.40	36.43***	3.48	38.91***	2.64
Constant*C_t	–8.69***	2.19	–8.51***	2.20	–7.72***	2.23	–8.84***	2.39
$\hat{R}_i$	5.86	3.65	7.15	4.74	8.01*	4.87		
$\hat{R}_i * C_t$	0.96	2.33	0.85	2.31	–2.86	3.14		
$\hat{R}_{it}$							–3.86	3.24
Capital$_{t-1}$	–0.59	0.46	–0.75	0.49	–1.30**	0.54	–1.70*	0.93
ROE$_{t-1}$	–0.06*	0.03	–0.06*	0.033	–0.03	0.045	–0.01	0.03
Liquidity$_{t-1}$	0.004	0.07	–0.002	0.07	–0.03	0.07	–0.05	0.07
Size$_{t-1}$			–0.95	1.82	–0.61	1.95	5.98	4.26
MFund$_{t-1}$	0.01	0.09	0.02	0.09	0.01	0.09	0.06	0.18
Signings$_{t-1}$	0.14	0.11	0.13	0.11	0.12	0.12	0.11	0.09
HHI (sectors)$_{t-1}$	–0.19***	0.06	–0.20***	0.06	–0.19***	0.06	–0.20**	0.10
HHI (countries)$_{t-1}$	0.02	0.04	0.02	0.04	0.06	0.04	0.07	0.08
FX signings$_{t-1}$	–0.01	0.04	0.002	0.04	0.006	0.04	0.04	0.07
Covenant $_{t-1}$	0.45	0.45	0.45	0.45	0.48	0.64	0.34	0.69
Capital$_{t-1}$*C_t					1.67***	0.60	1.55*	0.86
ROE$_{t-1}$*C_t					–0.10	0.06	–0.14*	0.07
Liquidity$_{t-1}$*C_t					0.24*	0.13	0.25**	0.10
Size$_{t-1}$*C_t					–1.31	1.62	–1.52	2.20
MFund$_{t-1}$*C_t					0.03	0.09	0.022	0.11
Signings$_{t-1}$*C_t					0.25	0.18	0.18	0.15
HHI (sectors)$_{t-1}$*C_t					–0.01	0.10	–0.03	0.18
HHI (countries)$_{t-1}$*C_t					–0.13**	0.06	–0.14	0.11
FX signings$_{t-1}$*C_t					–0.02	0.05	–0.03	0.07
Covenant $_{t-1}$*C_t					–0.24	0.89	–0.16	0.90
Accounting change	–3.42*	2.05	–3.47*	2.06	–2.35	2.14	–2.84	2.47
Time fixed-effects	In		In		In		In	
Observations	830		830		830		830	
Within R^2							0.13	
Rho	0.51		0.59		0.61		0.61	
Wald statistic	80.61		80.22		110.92			

[1] The sample period goes from 2000 to 2010. The dependent variable *leveraged loans* is equal to the percent share (in terms of the dollar amounts of participations) of leveraged loans in the portfolio of signings of each bank for each year. In regressions R5-R7, the *rescued banks* dummy variable $\hat{R}_i$ is equal to one over the entire sample period when a bank had at least a 50% probability of being rescued during 2008-10 as predicted by the Logit regression (model specification r3 in Table A1). In regression R8, the time-invariant *rescued banks* dummy has been replaced by a time-variant dummy $\hat{R}_{it}$ that is equal to one in the year when a bank was predicted to be rescued as well as thereafter, and zero otherwise. The crisis dummy variable C_t is equal to one during 2008 and 2010. "Fixed effects" denotes the fixed effects panel estimator and "Hausman Taylor" the Hausman-Taylor estimator for error-components models. "Within R^2" denotes the coefficient of determination within cross-sections (only available for fixed effects), "Rho" the share of the estimated variance of the overall error accounted for by fixed effects, and "Wald statistic" denotes the test statistic for the overall significance of the coefficients. Robust standard errors are reported. (***, **, *) indicate significance at the 1%, 5%, and 10% level. Independent variable definitions: see Table 3. Syndicated loan variables are averages (weighted by participation amounts) taken for banks' portfolios of signings every year.

Sources: BankScope, Dealogic, authors' calculations.

Table 7

Determinants of bank loan risk – Weighted average portfolio spreads[1]

Dependent variable:	R9		R10		R11		R12	
	Hausman Taylor		Hausman Taylor		Hausman Taylor		Fixed effects	
Spreads$_t$	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Constant	99.53***	10.57	96.75***	10.89	89.14***	10.93	111.5***	7.33
Constant*C_t	0.66	6.16	2.09	6.24	5.97	6.11	0.73	9.06
$\hat{R}_i$	37.92***	13.84	47.82***	15.81	53.74***	15.94		
$\hat{R}_i$*C_t	15.88**	6.53	15.21**	6.53	–5.32	8.63		
$\hat{R}_{it}$							19.2*	9.96
Capital$_{t-1}$	–3.09**	1.40	–3.58**	1.44	–4.95***	1.52	–5.63***	1.69
ROE$_{t-1}$	–0.14	0.09	–0.14	0.09	–0.06	0.12	–0.023	0.17
Liquidity$_{t-1}$	–0.25	0.19	–0.27	0.19	–0.35*	0.21	–0.51*	0.30
Size$_{t-1}$			–7.76	5.72	–9.67	5.93	2.02	15.3
MFund$_{t-1}$	–0.34	0.28	–0.28	0.29	0.03	0.29	0.36	0.56
Signings$_{t-1}$	–0.34	0.31	–0.37	0.31	–0.18	0.33	–0.36	0.27
HHI (sectors)$_{t-1}$	–0.10	0.17	–0.14	0.17	–0.09	0.18	–0.013	0.18
HHI (countries)$_{t-1}$	0.06	0.11	0.04	0.11	0.10	0.12	0.11	0.16
FX signings$_{t-1}$	0.29***	0.11	0.34***	0.12	0.45***	0.12	0.55***	0.21
Covenant $_{t-1}$	2.93**	1.26	2.97**	1.25	5.06***	1.75	4.35**	1.80
Capital$_{t-1}$*C_t					3.52**	1.66	1.97	2.43
ROE$_{t-1}$*C_t					–0.41**	0.18	–0.32	0.29
Liquidity$_{t-1}$*C_t					1.30***	0.35	1.23***	0.46
Size$_{t-1}$*C_t					1.71	4.45	–5.87	8.89
MFund$_{t-1}$*C_t					–0.90***	0.24	–0.92**	0.44
Signings$_{t-1}$*C_t					0.59	0.48	0.66	0.65
HHI (sectors)$_{t-1}$*C_t					0.16	0.29	0.059	0.42
HHI (countries)$_{t-1}$*C_t					–0.36**	0.18	–0.37	0.30
FX signings$_{t-1}$*C_t					–0.39***	0.14	–0.29	0.28
Covenant $_{t-1}$*C_t					–5.39**	2.43	–5.18	3.15
Accounting change	–9.39	5.90	–9.46	5.89	–1.18	5.93	0.27	7.37
Time fixed-effects	In		In		In		In	
Observations	830		830		830		830	
Within R^2							0.21	
Rho	0.67		0.69		0.71		0.72	
Wald statistic	84.44		86.62		178.43			

[1] The sample period goes from 2000 to 2010. The dependent variable *spread* is equal to the average spread (in basis points, weighted by participation amounts) of the portfolio of syndicated loan signings of each bank for each year. In regressions R9-11, he *rescued banks* dummy variable $\hat{R}_i$ is equal to one over the entire sample period when a bank had at least a 50% probability of being rescued during 2008-10 as predicted by the Logit regression (model specification r3 in Table A1). In regression R12, the time-invariant *rescued banks* dummy has been replaced by a time-variant dummy $\hat{R}_{it}$ that is equal to one in the year when a bank was predicted to be rescued as well as thereafter, and zero otherwise. The crisis dummy variable C_t is equal to one during 2008 and 2010. "Fixed effects" denotes the fixed effects panel estimator and "Hausman Taylor" the Hausman-Taylor estimator for error-components models. "Within R^2" denotes the coefficient of determination within cross-sections (only available for fixed effects), "Rho" the share of the estimated variance of the overall error accounted for by fixed effects. "Wald statistic" denotes the test statistic for the overall significance of the coefficients. Robust standard errors are reported. (***, **, *) indicate significance at the 1%, 5%, and 10% level. Independent variable definitions: see Table 3. Syndicated loan variables are averages (weighted by participation amounts) taken for banks' portfolios of signings every year.

Sources: BankScope, Dealogic, authors' calculations.

the crisis (measured by the coefficient on $\hat{R}_i * C_t$) is now insignificant: rescued banks did neither increase nor reduce their loan risk relatively more than their non rescued peers during the crisis. We surmise that the significantly positive coefficients in Section 3.1 on $R_i * C_t$ (suggesting that rescued banks continued to take on additional risk during the crisis), are biased by the endogeneity of public rescues.

Further, we note a number of interesting results regarding bank-specific drivers of risk. Firstly, the capital position of banks during normal times is significantly and negatively related to the share of leveraged loans in the portfolio (regression R7) and to the weighed average spread (regressions R9-R11). This could possibly indicate that banks have been trying to save on capital charges related to the risk in their lending activities (eg by moving loans off balance sheet or selling them on the secondary market). Or else it could reflect that the higher capitalisation of some banks mirrors their greater risk aversion. However, once the capitalisation variable is interacted with the crisis dummy, it turns out significant and positive (regressions R7 and R11). This could point to the better alignment between capital and risk during the crisis (either through the capital injections that were part of the rescue operations or through the running-down of higher capital cushions built up before the crisis.[22] Secondly, once public bailouts are treated as endogenously determined, banks with a higher portfolio concentration in specific sectors (as measured by the sectoral HHI) are found to exhibit lower risk measures (regressions R6–R7). This might be explained by the fact that specialisation in specific sectors yields information advantages which reduce risk incentives by increasing profits. Finally, higher shares of signings in foreign currency[23], or with covenants attached, are associated with higher spreads (regressions R10–R11), pointing to higher risk originating from currency mismatches, and to the fact that it may be riskier borrowers who require covenants.

Results with time-varying instruments: treatment response or the direct impact of bank rescues on risk

The time-varying version of the instrumented rescue variables allows to gauge the causal impact of the rescue packages on risk more explicitly. In order to do this, we replaced the time-invariant instrumented rescue dummy $\hat{R}_i$ with a *time-variant* rescue dummy $\hat{R}_{it}$ set to 1 in the year where a bank had a predicted probability of being rescued during the financial crisis of at least 50%, *as well as in the years thereafter.* This approach is tantamount to a treatment regression which focuses on the causal effect of bank rescues on risk. It does not, however, allow inferring differences in risk before the rescues. Since the rescue dummy variable is now time-variant, the fixed-effects estimator is appropriate instead of the Hausman-Taylor estimator. The results (regressions R8 and R12) show that rescued banks' risk has not fallen relatively more compared to non rescued banks in response to the recapitalisations. In the case of loan leverage we do not find a significant impact of the rescues on risk. In the case of spreads, we find evidence that spreads of rescued banks increased by 19bp in response to the rescues. Without significantly changing the fraction of leveraged loans in their portfolio, rescued banks tended to charge higher loan spreads. That may reflect that their ability to provide loans at competitive spreads was compounded by their larger write downs and higher funding costs that they have been facing during the crisis.

[22] We obtain similar (albeit weaker) relationships between banks' risk and their liquidity position.

[23] in currencies different from the lender's home currency

4. Robustness checks

In this section we present the results of robustness checks with regard to (i) the selection of the crisis window, (ii) excluding the US market, and (iii) risk at home versus abroad. We discuss these three aspects in turn. The results are reported in Table 8 (dependent variable: share of leveraged loans in the portfolios of signings) and Table 9 (weighted average spreads on the portfolios of signings). They were calculated using the time-invariant instrumented version of the rescue dummy variable (cf. Section 3.2).

Table 8

Robustness checks – Share of leveraged loans in portfolio of signings[1]

Dependent variable: *Leveraged loans$_t$*	R13 Crisis 2008-09		R14 Exclude US banks		R15 Leveraged loans at home	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Constant	37.04***	3.39	34.76***	3.68	14.94***	3.01
Constant*C_t	–5.25**	2.37	–6.17**	2.77	–1.92	1.72
$\hat{R}_i$	8.11*	4.71	4.17	5.17	10.57**	4.36
$\hat{R}_i$*C_t	–3.73	3.52	–6.09	3.77	0.21	2.41
Capital$_{t-1}$	–1.21**	0.52	–0.81	0.65	–0.51	0.42
ROE$_{t-1}$	–0.07*	0.04	–0.03	0.05	–0.03	0.03
Liquidity$_{t-1}$	0.01	0.07	–0.01	0.09	–0.10*	0.06
Size$_{t-1}$	–0.20	1.86	0.02	2.16	–2.87*	1.64
MFund$_{t-1}$	–0.02	0.10	0.08	0.11	0.02	0.08
Signings$_{t-1}$	0.048	0.12	0.13	0.24	0.07	0.09
HHI (sectors)$_{t-1}$	–0.17***	0.062	–0.18**	0.07	–0.18***	0.05
HHI (countries)$_{t-1}$	0.060	0.041	0.06	0.05	0.09***	0.03
FX signings$_{t-1}$	–0.00	0.04	–0.00	0.05	–0.07**	0.03
Covenant $_{t-1}$	0.68	0.50	0.10	0.98	0.18	0.49
Capital$_{t-1}$*C_t	1.86***	0.65	1.41**	0.72	1.12**	0.46
ROE$_{t-1}$*C_t	–0.01	0.06	–0.07	0.07	–0.004	0.05
Liquidity$_{t-1}$*C_t	0.21	0.14	0.29*	0.15	0.13	0.10
Size$_{t-1}$*C_t	–2.01	1.83	–2.36	1.95	–1.34	1.24
MFund$_{t-1}$*C_t	0.05	0.10	0.11	0.10	–0.007	0.07
Signings$_{t-1}$*C_t	0.16	0.19	0.02	0.30	0.040	0.14
HHI (sectors)$_{t-1}$*C_t	–0.07	0.12	0.01	0.12	–0.04	0.08
HHI (countries)$_{t-1}$*C_t	–0.15**	0.07	–0.13*	0.07	–0.15***	0.05
FX signings$_{t-1}$*C_t	–0.02	0.06	0.02	0.06	–0.03	0.04
Covenant $_{t-1}$*C_t	–0.08	1.05	2.05	1.71	–0.60	0.69
Accounting change	–2.87	2.08	–0.88	2.44	–2.08	1.67
Time fixed-effects	In		In		In	
Observations	830		670		830	

[1] The sample period goes from 2000 to 2010. The dependent variable *leveraged loans* is equal to the percent share (in terms of the dollar amounts of participations) of leveraged loans in the portfolio of signings of each bank for each year. "Crisis 2008–09" indicates that the crisis window goes from 2008–09 instead of 2008–10, "Exclude US banks" that the estimations have been done without banks headquartered in the US, and "Leveraged loans at home" that the dependent variable has been replaced by leveraged lending at home. The estimations are based on regression R7 and use the Hausman-Taylor estimator. Robust standard errors are reported. (***, **, *) indicate significance at the 1%, 5%, and 10% level. Independent variable definitions: see Table 3. Syndicated loan variables are averages (weighted by participation amounts) taken for banks' portfolios of signings every year.

Sources: BankScope, Dealogic, authors' calculations.

Table 9

Robustness checks – Weighted average portfolio spreads

Dependent variable: $Spread_t$	R16 Crisis 2008-09		R17 Exclude US banks		R18 Spreads at home	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Constant	91.34***	11.31	86.37***	10.39	58.61***	11.03
Constant*C_t	5.42	6.65	–2.67	7.24	3.70	7.02
$\hat{R}_i$	55.37***	16.53	36.03**	15.34	58.13***	15.45
$\hat{R}_i$*C_t	–4.72	9.92	–12.71	9.92	–17.17*	9.90
$Capital_{t-1}$	–4.56***	1.52	–3.70**	1.77	–3.13*	1.68
ROE_{t-1}	–0.08	0.11	–0.08	0.13	0.11	0.14
$Liquidity_{t-1}$	–0.30	0.20	–0.51**	0.23	0.34	0.23
$Size_{t-1}$	–8.40	5.95	–10.40*	6.04	–9.11	6.34
$MFund_{t-1}$	–0.07	0.29	0.49	0.30	–0.18	0.32
$Signings_{t-1}$	–0.36	0.34	0.66	0.62	–0.02	0.37
HHI $(sectors)_{t-1}$	–0.13	0.18	–0.03	0.19	–0.43**	0.21
HHI $(countries)_{t-1}$	0.14	0.12	0.06	0.13	0.26*	0.15
FX $signings_{t-1}$	0.50***	0.12	0.44***	0.13	0.11	0.14
Covenant $_{t-1}$	4.31***	1.39	6.82***	2.55	2.68	1.97
$Capital_{t-1}$*C_t	2.36	1.85	2.71	1.92	2.11	1.87
ROE_{t-1}*C_t	–0.33*	0.18	–0.36*	0.19	–0.91***	0.27
$Liquidity_{t-1}$*C_t	1.08***	0.39	1.06***	0.40	0.74*	0.40
$Size_{t-1}$*C_t	–4.12	5.18	–2.61	5.19	8.21	5.18
$MFund_{t-1}$*C_t	–0.64**	0.26	–0.43	0.28	–1.38***	0.27
$Signings_{t-1}$*C_t	0.63	0.53	0.81	0.78	1.31**	0.55
HHI $(sectors)_{t-1}$*C_t	0.34	0.37	0.05	0.34	0.82**	0.37
HHI $(countries)_{t-1}$*C_t	–0.58***	0.21	–0.32	0.20	–0.45**	0.21
FX $signings_{t-1}$*C_t	–0.39**	0.16	–0.06	0.16	–0.89***	0.17
Covenant $_{t-1}$*C_t	–5.14*	2.95	–10.56**	4.45	–2.11	2.74
Accounting change	–5.64	5.91	–2.28	6.46	10.53	6.70
Time fixed-effects	In		In		In	
Observations	830		670		830	

[1] The sample period goes from 2000 to 2010. The dependent variable *spread* is equal to the average spread (in basis points, weighted by participation amounts) of the portfolio of syndicated loan signings of each bank for each year. "Crisis 2008-09" indicates that the crisis window goes from 2008-09 instead of 2008-10, "Exclude US banks" that the estimations have been done without banks headquartered in the US, and "Spreads at home" that the dependent variable has been replaced by the weighted average spread on syndicated loans written in the home market. The estimations are based on regression R11 and use the Hausman-Taylor estimator. Robust standard errors are reported. (***, **, *) indicate significance at the 1%, 5%, and 10% level. Independent variable definitions: see Table 3. Syndicated loan variables are averages (weighted by participation amounts) taken for banks' portfolios of signings every year.

Sources: BankScope, Dealogic, authors' calculations.

4.1 Are the main findings regarding rescued banks' higher risk robust to alternative crisis windows?

We experimented with a number of different crisis windows, to ascertain if and how our main findings change during various episodes of the crisis. To be sure, the period 2008-2009 comprised the most severe financial turmoil, which subsequently became protracted with the onset of the European sovereign debt crisis in 2010. This explains why we initially chose the

period 2008-2010 as our crisis window. When we use 2008-2009 as the crisis window, the results are essentially unchanged: before the crisis, rescued banks took on higher risks than non rescued banks, and with the advent of the crisis they did not reduce their risk by more than non rescued banks (regressions R13 and R16).

4.2 Results excluding US banks

The US market is a particularly significant segment of the global syndicated loan market, and US banks provided up to 15% of global signings during 2000–10, close to 80% of which was home lending (Table 2). Moreover, US banks' involvement in the syndicated loan market as a share of their total assets is also the highest among all bank nationalities in our sample. We have re-estimated our regression excluding US banks, to check if the main results are driven by US banks' behaviour. The estimates (regressions R14 and R17) are consistent with our main results: rescued banks have taken on higher risk before the crisis than non rescued banks. However, the relationship between the rescued status and the share of leveraged loans in the portfolio is somewhat weaker than for the whole sample of banks.

4.3 Riskiness of home versus foreign lending

Did rescued banks incur higher risk relative to non rescued banks mainly in their home markets, or was it also apparent in their foreign syndicated lending activities? The answer to this question can give indications regarding regulatory arbitrage. For instance, higher risk mainly at home, where the expectation of a bailout by the home authorities can be higher, could constitute evidence of such arbitrage. Figures 5a and 5b present some tentative evidence of this. We have computed the same risk indicators as in Figure 3 (loan leverage classification in the portfolio, average portfolio spreads, average borrower ratings migrations, average portfolio pricing errors) for rescued versus non rescued banks, but distinguishing between domestic and foreign syndicated lending. As before, we defined home lending as cases where the ultimate nationality of the lender matches the ultimate nationality of the borrower. This partitioning shows that rescued banks have incurred higher risk (in the form of higher average spreads and a higher share of leveraged loans in the portfolios; and in terms of more pronounced downward ratings migrations) essentially at home (Figure 5a). Our measures of risk are much more comparable between rescued and non rescued banks when foreign syndicated lending is considered (Figure 5b). This could reflect rescued banks' expectation that rescues are more likely to occur at home, where they may count as more systemic or wield more market power than abroad, where competition may be higher.[24]

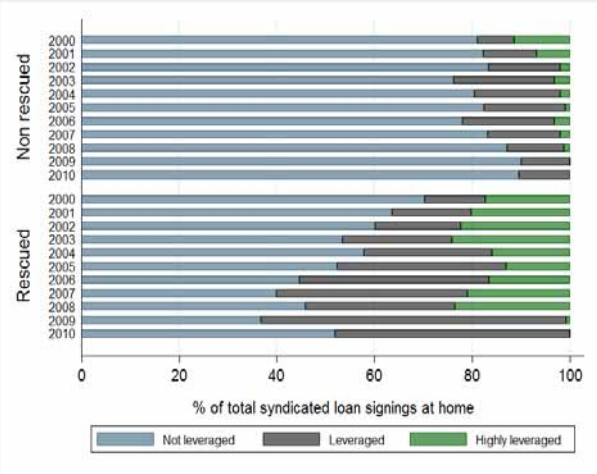
To corroborate these results econometrically, we have re-run our regressions on sub-samples of syndicated bank lending in domestic markets (regressions R15 and R18). The home lending regressions yield coefficients on $\hat{R}_i$ which are in absolute terms higher than on the whole sample regressions, indicating that the significantly higher risk of rescued banks was apparent mainly in their home markets.

[24] This is assuming that the home authorities base their bailout decision on their concerns about the impact of a bank's failure on the *domestic* financing that it provides. There have, of course, been instances where banks got in trouble with their international businesses (eg European banks' exposure to US toxic assets) and still got a bailout from the home authorities, because of their systemic importance at home.

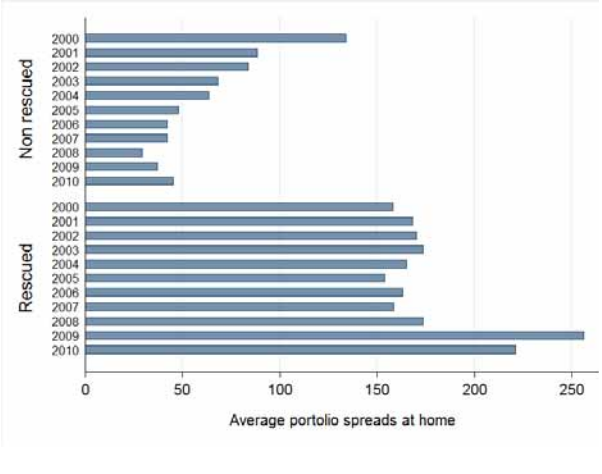
Figure 5a

Risk in the syndicated loan market by bank type: domestic lending

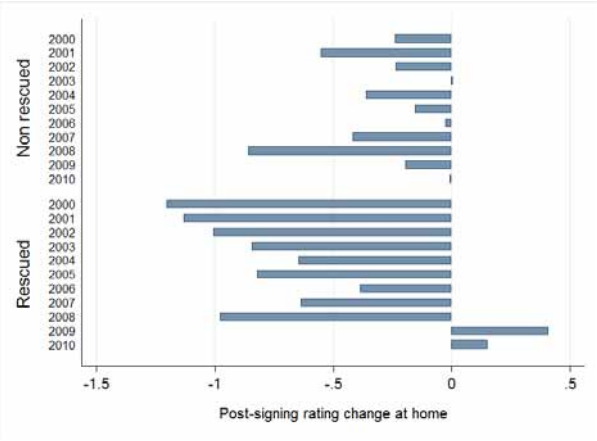
Loan leverage[1] classification in portfolio



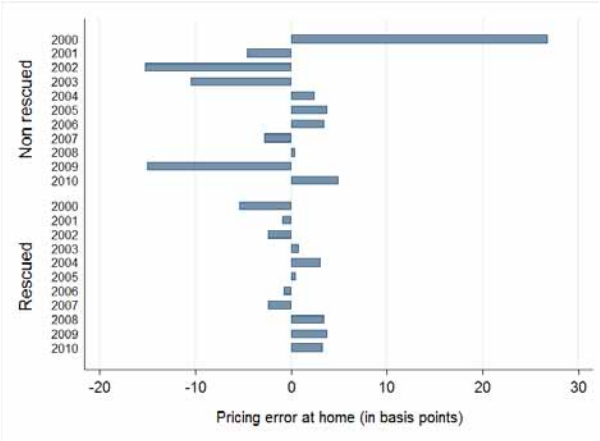
Average[2] portfolio spread



Average[2] post-signing rating change[3] in portfolio



Average[2] portfolio pricing error[4]



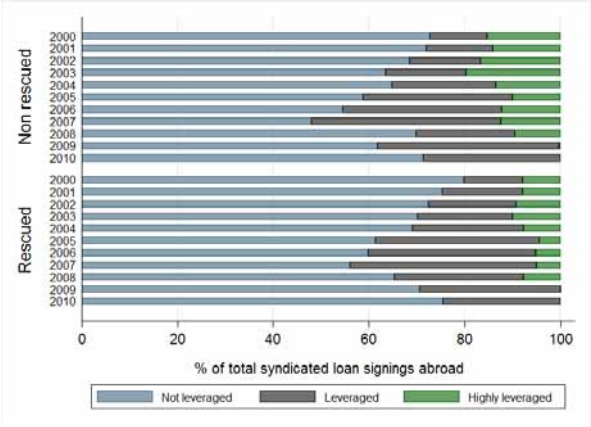
Notes: [1] In % of participation amounts. The category "highly leveraged" was merged with the "leveraged" category in 2009. [2] Weighted by loan participation amounts. [3] Difference (in notches) between the borrower's current rating and the rating at signing, with the higher scores corresponding to better ratings. As such, a score of +2 should read as an average post-signing upgrade of two notches in the portfolio. [4] Difference between the observed spread over Libor, and the spread predicted by a linear regression incorporating observable loan features (size, maturity, guarantees, collateral, facility purpose and type), borrower characteristics (sector, rating, first time borrower) and the state of the market (total volumes, level of interest rates).

Sources: BankScope, Dealogic, authors' calculations.

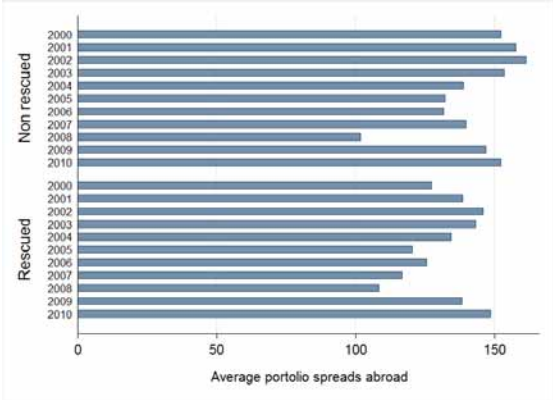
Figure 5b

Risk in the syndicated loan market by bank type: foreign lending

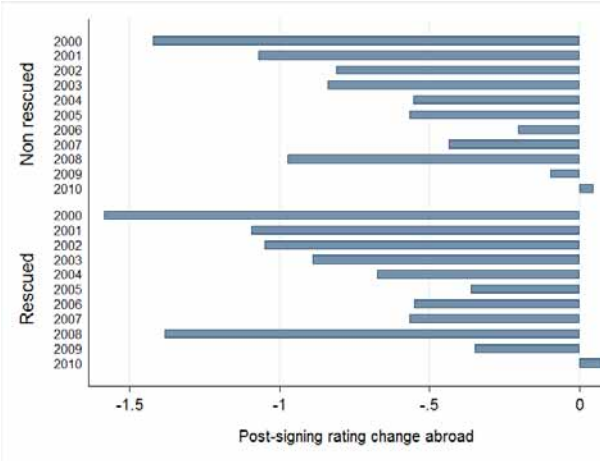
Loan leverage[1] classification in portfolio



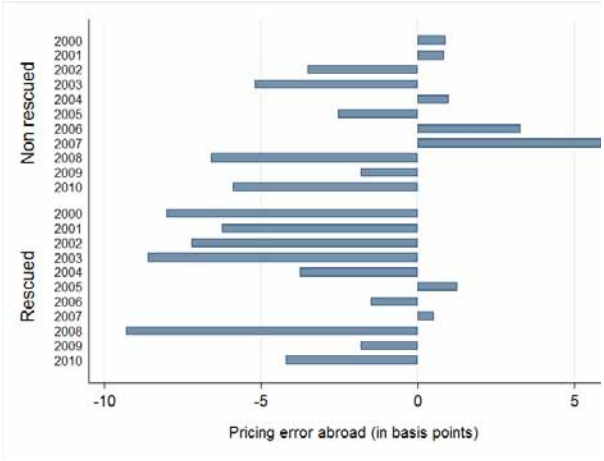
Average[2] portfolio spread



Average[2] post-signing rating change[3] in portfolio



Average[2] portfolio pricing error[4]



Notes: [1] In % of participation amounts. The category "highly leveraged" was merged with the "leveraged" category in 2009. [2] Weighted by loan participation amounts. [3] Difference (in notches) between the borrower's current rating and the rating at signing, with the higher scores corresponding to better ratings. As such, a score of +2 should read as an average post-signing upgrade of two notches in the portfolio. [4] Difference between the observed spread over Libor, and the spread predicted by a linear regression incorporating observable loan features (size, maturity, guarantees, collateral, facility purpose and type), borrower characteristics (sector, rating, first time borrower) and the state of the market (total volumes, level of interest rates).

Sources: BankScope, Dealogic, authors' calculations.

Concluding remarks

Based on their activity on the syndicated loan market during the period 2000–10, we have in this paper analysed the loan risk of a sample of 87 large banks, 40 of which received public recapitalisations during 2008-10. We find that before the crisis, rescued institutions had a significantly higher share of leveraged loans in their portfolios of syndicated loan signings than their non rescued peers. They have participated in loans carrying significantly higher Libor spreads (albeit more underpriced with respect to a standard benchmark), higher maturities, and associated with more post-signing borrower downgrades, than non rescued banks. Rescued banks have incurred this higher risk mainly at home, possibly reflecting their

expectation that rescues are more likely to occur at home, where they may count as more systemic or wield more market power than abroad. The risk reflected in their foreign syndicated lending, where competition may be stronger, is much more comparable to that of non rescued banks. Although risk started diminishing across the board in 2009, we fail to find significant consistent evidence that with the onset of the crisis in 2008, rescued banks have reduced their risk relatively more than non rescued banks.

In the first instance, these results are based on the analysis of the characteristics of banks' portfolios of syndicated loan signings. They are substantiated by regression analysis where risk is explained as a function of bank balance sheet and syndicated loan portfolio characteristics and macro factors, and where we allow for the possibility that bank rescues are endogenously determined. A limitation of the analysis however is the focus on only one facet of banking business: the international syndicated loan market. At the utmost, syndicated loan issuance accounts for 10% of the total assets of the banks in our sample and as such, it cannot characterise their overall behaviour. However, we find that indicators based on this market do provide interesting risk information not contained in market-based proxies or balance sheet indicators such as CDS spreads, EDFs or non-performing loan ratios.

It is not surprising that rescued banks' (syndicated) lending behaviour was riskier than that of non rescued ones prior to the rescues. Indeed, it is consistent with the literature on the effect of (actual or expected) state support on bank risk. Rescued banks may either be erring in risk management or consciously taking advantage of the implicit bailout guarantee. It could also be that rescued banks' inefficiency in providing loans at competitive spreads is compounded by the higher funding costs that they have been facing themselves during the crisis. The absence, in response to the crisis and the public rescue packages, of reduction in rescued banks' risk relative to non rescued institutions warrants further cost-benefit analysis of the rescue operations.

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Appendix: Sample construction

The initial sample of banks comprises 108 major bank holding companies from 14 countries as in Brei et al (2011). It corresponds to those large internationally active banks on which public rescue information is available, augmented with a control sample of large internationally active banks which did not receive a public rescue. Yearly observations were taken for the period 2000–10. Financial statements have been adjusted for large mergers and acquisitions. Over the sample period, we adjusted for 5 mergers and 99 acquisitions that involved close to US$16 trillion of assets in total. Of the 104 mergers and acquisitions, 22 were cross-border.

We combined information on banks' balance sheets with their portfolios of syndicated loan signings, constructed using information about specific banks' participation in individual loan syndications. Because some banks have participated only marginally in syndicated loan agreements, we have excluded 21 banks from the initial sample (requiring that banks have at least 6 annual observations), which reduced the final sample of banks to 87 institutions.

The recent financial crisis was associated with a number of major mergers and acquisitions or splits experienced during the crisis, including the resolutions of ABN AMRO (Netherlands), Fortis (Belgium) and the Spanish Caixas. For some acquisitions and splits it was impossible to adjust the financial statements using the BankScope database and we dropped these observations for estimation, and replaced/extrapolated them for the graphs. This ensured a balanced sample of banks for the graphs.

Box 1

Micro- and macro-economic determinants of bank risk and bailouts

High *capital* cushions are a priori less likely to be associated with bailouts as they strengthen monitoring incentives (Holmstrom and Tirole (1997), Mehran and Thakor (2011)) and reduce incentive distortions (Hellmann et al (2000)). On the other hand they allow to take on more risk (through the mechanical effect of the capital ratio, see (Schaeck and Čihák (2011)). Similarly, risk would tend to increase if a bank's survival probability, implied by the high level of capital, becomes too large and inelastic with respect to its risk choices (Calem and Robb (1999)).

Likewise, *profitability* is on the one hand expected to be significantly and negatively associated with risk and bailout probabilities, as retained profits can serve to build up equity. High (expected) profits also increase banks' franchise value (the discounted sum of future profits), which provides incentives against excessive risk because higher franchise values increase expected default costs (Boot and Schmeits (2000)). On the other hand, high profits may simply reflect a risky investment portfolio. The relationship between profitability, risk and the need for bailouts is therefore undetermined.

The expected sign on *liquidity* is uncertain as well. Indeed, liquid assets serve as a cushion to meet obligations; however, holding them is costly, impairs profits and provides an incentive to search for yield.

Regarding *size*, large international banks tend to be in a better position to diversify their risks and to absorb sector- or country-specific shocks, owing to their global scope and access to international capital. Indeed, the theoretical models by Diamond (1984), Williamson (1986) and Allen (1990) predict economies of scale in intermediation linked to diversification. There are, however, costs associated with bank size, such as the difficulty to manage such complex institutions properly (Cerasi and Daltung (2000)). There exists empirical evidence that, although large banks benefit from a diversification advantage, they do not translate this into less risk and pursue riskier strategies with lower capital ratios (Demsetz and Strahan (1997), De Nicolò (2000)). Due to the detrimental negative externalities of large banks when they fail, they are more likely to be bailed out because of their systemic importance.

Market funding (measured by total liabilities minus deposits as a share of assets) can serve as an additional funding source in times when it is difficult to obtain client deposits. However, reliance

on market funding also makes the bank more vulnerable to a dry-up of liquidity from money market funds or on the interbank market (Berlin and Mester (1999), Shleifer and Vishny (2009), Huang and Ratnovski (2011)). As with profitability, the relationship between reliance on market funding, risk and the need for bailouts is therefore undetermined.

While the growth of the lending book can reflect good management and increased profits, unsustainable lending booms can be advance indicators of crises. We have included *loan growth* (the growth rate in the bank's total loan book as indicated by its balance sheet) and we expect it to be positively related to risk and bailouts.

We include banks' *syndicated loan signings relative to their total assets,* to gauge bank activity in the syndicated loan market segments. This measure can be negatively associated with risk and bailouts, because a higher ratio of syndicated loans to total assets supposedly tends to generate more stable interest revenues compared to more volatile returns derived from securities dealing, proprietary trading or investment banking. Likewise, more active participation in the syndicated loan market allows banks to engage in more risk sharing with other banks and to sell off risk on the secondary market for such loans.

Higher *leveraged lending*, higher *spreads*, higher *maturities* and more borrower *downgrades* are associated with higher potential losses and a higher probability of bailout. Inasmuch as lenders are likely to have greater knowledge of the home business, a higher share of *home lending* in the portfolio is supposedly less risky and less conducive to bailouts. However, other things being equal, national authorities may be likelier to bail out domestic players, which would argue for a positive relationship between home lending and the probability of a bailout.

The relationship between portfolio *concentration*, risk and the need for bailouts is uncertain. Concentration may increase the cost-efficiency of monitoring (Winton (1999), Rossi et al (2009), Tabak (2011)). However, diversification increases profit efficiency (García-Herrero and Vazquez (2007), Rossi et al (2009)). Likewise, *covenants*[①] can mitigate as well an increase in risk. By mechanically triggering penalties if the borrower fails to meet certain obligations or gets a rating downgrade, these contractual clauses offer more protection to the lender. That being said, covenants also mechanically trigger more defaults in case of financial hardship.[②] A higher share of *foreign currency* signings might be an indication of increased bank fragility if the positions are unhedged. Finally, the *growth in* syndicated loan *signings* can also be indicative of a lending boom and positively related to risk and bailouts.

Low *interest rates* tend to increase asset and collateral values, which in turn increase the value of equity relative to corporate debt. This mechanism tends to decrease banks' risk perception. In addition, low interest rates may induce loan officers to grant more loans to low rated borrowers as they seek to invest in higher yielding assets (Rajan (2005)). This argues in favour of a negative relationship between the level of interest rates and bailouts (Altunbaş et al (2010)).

GDP growth and *asset prices* mean more profitable lending opportunities, fewer defaults and higher collateral values (Kayshap et al (1993)). However, they can also be associated with unsustainable credit bubbles and the relationship with bank bailouts depends on the country's circumstances (Altunbaş et al (2010)). So we do not have a strong prior on the sign of these controls.

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① Following Gadanecz (2011), we have used three proxies for the presence of covenants: presence of at least one financial covenant; presence of a covenant in respect of the net worth or current ratio; and the number of covenants (for facilities that have at least one financial covenant). In the final estimations we use the second proxy.

② Indeed, borrowers are more likely to breach pre-defined obligations in an economic downturn and are then technically considered to be in default without getting a chance to re-negotiate the loan agreement.

Box 2

Does banks' risk predict bailouts?

In this modelling exercise, we wish to test whether banks' risk predicts any public bailout operations. The dependent variable is a dummy variable B_{it} that identifies the timing of the public bank rescues. We set B_{it} to one in the year t_R when a bank *i* received a public recapitalisation, as well as in subsequent years. Otherwise, if the bank has not received a public recapitalisation, B_{it} is set to zero for all years. Therefore, for a rescued bank *i*, the following definitions hold:
$B_{it} = 1 \; if \; t \geq t_R \; and \; B_{it} = 0 \; if \; t < t_R$.
In this sense, bank rescues can be interpreted as a bank-specific treatment that started with the recapitalisation. We use the following logistic regression (estimated by maximum likelihood) to predict these bailouts:

$$\Pr(B_{it} = 1 \mid V_{it-1}) = \frac{1}{1 + \exp(-\beta V_{it-1} - \beta_i)} + \varepsilon_{it},$$

where the vector of explanatory variables V_{it-1} includes bank-specific information taken from the financial statements (such as bank capital, liquidity, size, profitability, market funding, loan growth), various average measures based on the banks' syndicated loan portfolio (total signings relative to the bank's balance sheet size, the growth rate of syndicated lending, post-signing rating changes, average spreads, average maturities, concentration indices and the share of signings in foreign currency or with covenants), as well as macroeconomic control variables (nominal GDP, interbank market rate, stock prices and house prices). Because of endogeneity concerns, the bank and syndicated loan characteristics have been lagged by one year. The error term is denoted by ε_{it}, and β_i indicates unobserved fixed- or random-effects. Table 3 contains definitions and summary statistics for the variables. The expected signs of the coefficients are discussed in Box 1. An overview is provided in Table 4.

We tried several specifications. This involved experimenting with different estimators (the logit estimator without or with time-invariant fixed- or random-effects), definitions of the dependent variable, lag dimensions for the explanatory variables, and various combinations of micro- and macro controls. The final specification was chosen in terms of parsimony, the number of correctly predicted rescues (maximized), the number of "false alarms" (rescues predicted when nothing happened; minimized), and the explanatory power of the model (measured by the value of the log-likelihood function).

The results of our preferred specification (regression r3) are shown in Table A1, column 3. Overall the estimated coefficients are robust across the three specifications; however, the ratio of correctly predicted rescues over false alarms is highest in regression r3. Out of a total of 87 banks, of which 40 have been rescued, this model identified 37 institutions with a probability of at least 50% of being rescued during 2008-10. In 27 cases the rescues have been correctly identified, while in 10 cases there was a high probability of being rescued although nothing happened.[①] These 37 banking institutions represent our instrument set of rescued banks used in Section 3.2 where we allow for the endogeneity of public bailouts when estimating bank risk

As expected, the rescue probability decreases with bank profits (measured by ROE), confirming that more profitable banks are less likely to need state help). It increases with bank size, corroborating the too-big-to fail hypothesis. An increase in liquidity and capital increases the rescue probability. In the case of liquidity, this could point to a search for yield strategy (as highly liquid assets are low-yielding) or to a larger trading book. The positive coefficient on capital could be related to the mechanical effect of higher capital requirements when banks take more risk. Regarding the characteristics of the syndicated loan portfolio, a higher share of leveraged (hence riskier) loans, higher maturities and higher sectoral concentration are associated with significantly higher rescue probabilities. Longer maturities mean that the risk is borne for a longer period of time and through higher sectoral concentration, the bank foregoes the risk lowering the effect of diversification. A higher share of signings in foreign currency is associated with lower rescue probabilities. As far as macroeconomic determinants are concerned, it appears that higher stock and house price growth reduce the probability of being rescued (presumably by pushing up collateral values).

[①] Among these "false alarms" are some banks that were offered money by the government but turned it down due to reputational concerns. Some institutions received a private sector bailout instead. Our type 1 errors also include rescued institutions for which our model does not predict a public bailout. Even though they may have been intrinsically sound taken on their own, the authorities may have forced them to take state funds because of their interconnectedness with other banks, the rest of the financial system and the real economy.

Table A1

Determinants of public bailouts[1]

Dependent variable: *Rescue dummy*	r1 Logit		r2 Logit		r3 Logit	
	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Balance sheet characteristics						
Capital$_{t-1}$	0.70***	0.22			0.59**	0.25
ROE$_{t-1}$	–0.09***	0.02			–0.11***	0.032
Liquidity$_{t-1}$	0.11***	0.03			0.13***	0.043
Size$_{t-1}$	3.43***	0.86			3.49***	1.06
MFund$_{t-1}$	0.02	0.04			0.03	0.04
Loan growth$_{t-1}$	0.01	0.02			0.01	0.02
Syndicated loan characteristics[2]						
Rating change$_{t-1}$			0.20	0.23	–0.075	0.45
Leveraged loans$_{t-1}$			0.04***	0.01	0.05**	0.02
Spread$_{t-1}$			0.001	0.005	0.004	0.01
Signings$_{t-1}$			0.04	0.03	0.09	0.06
HHI (sectors)$_{t-1}$			0.03*	0.02	0.07**	0.03
HHI (countries)$_{t-1}$			–0.04***	0.01	–0.01	0.02
Maturity$_{t-1}$			0.23**	0.11	0.59**	0.23
FX signings$_{t-1}$			–0.03**	0.01	–0.07***	0.02
Covenants$_{t-1}$			0.09	0.14	0.05	0.22
Signings growth$_{t-1}$			–0.01	0.003	–0.01	0.004
Macroeconomic controls						
GDP growth$_{t-1}$	–0.38*	0.21	–0.25*	0.14	–0.07	0.23
Δ *Interest rate*$_{t-1}$	0.38	0.31	0.23	0.22	0.05	0.36
Stock price growth$_{t-1}$	–0.06***	0.02	–0.04***	0.01	–0.09***	0.03
House price growth$_{t-1}$	–0.34***	0.07	–0.29***	0.05	–0.40***	0.10
Constant	–6.03***	1.13	–3.78***	0.77	–9.60***	2.28
Summary statistics						
Observations	859		750		750	
Log Likelihood	–164.13		–176.02		–138.69	
Correctly predicted rescues	20		25		27	
Falsely predicted rescues	11		12		10	

[1] The sample period goes from 2000 to 2010. The dependent variable *rescue dummy* is equal to one in the year a bank received a public recapitalization and thereafter, and zero otherwise. *"Logit"* refers to the panel logit estimator with random effects. "Log Likelihood" denotes the value of the log-likelihood function evaluated at the maximum. "*Correctly predicted rescues"* is equal to the number of rescued banks that have been correctly identified by model (threshold: probability of being rescued is larger than 50%). "*Falsely predicted rescues"* is equal to the number of banks that have been identified by the model of being rescued although they have not been subject to a public recapitalisation. Robust standard errors are reported. (***, **, *) indicate significance at the 1%, 5%, and 10% level. Independent variable definitions: see Table 3. [2] Yearly weighted averages in bank's portfolio of signings.

Sources: BankScope, Dealogic, authors' calculations.